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MANUAL PART NO.
2107-808890-00

GOULD 2800S RECORDERS
INK WRITING MODELS
OPERATORS AND SERVICE MANUAL
(S/N 2001 AND ABOVE)

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Gould Inc., Recording Systems Division
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WARNING

IN PATIENT CARE APPLICATIONS

ISOLATION TRANSFORMER

(Gould P.N. 882895-3(115V),-4(230V) or equal)

MUST BE CONNECTED BETWEEN

POWER SOURCE AND RECORDER

The following information is intended to alert the user to possible dangers and important information contained in this manual. The "WARNINGS" and "CAUTIONS" do not eliminate the dangers that they signal. Close attention to the information supplied plus "common sense" operation are the major accident prevention measures.

WARNING:	**Failure to follow this warning may result in bodily injury.**

CAUTION:	**Failure to follow this caution may result in possible damage to the product or equipment.**

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WARRANTY

CURRENT EQUIPMENT:

Gould Inc.'s Recording Systems Division's products as shown in the Current Equipment Catalog are warranted for a period of one year from date of shipment to original purchaser. Exceptions: the thermal pen in the 110 Strip Chart Recorder is guaranteed for life; the magnetic head assemblies in the Tape Recorder are warranted for 1000 hours of use or one (1) year from date of first shipment whichever occurs first; and the mainframe computer for Data Acquisition Systems and their associated software programs are warranted for 90 days. The IBM PC-AT computer is warranted for one (1) year.

Gould's products are warranted to conform to the applicable published specifications in effect at the time of shipment, and to be free from any defects in material or manufacture when used with recommended Gould associated equipment and Gould chart paper. GOULD'S LIABILITY UNDER SUCH WARRANTY IS LIMITED TO SERVICING OR REPLACING DEFECTIVE PARTS EXCEPT PENS, STYLI, FUSES AND BATTERIES AND DOES NOT INCLUDE CALIBRATION AND MINOR MAINTENANCE AS OUTLINED IN GOULD OPERATING MANUALS. IN NO EVENT SHALL GOULD BE LIABLE UNDER ANY CIRCUMSTANCES, FOR ANY LOSS OF PROFITS OR OTHER CONTINGENT, CONSEQUENTIAL OR SPECIAL DAMAGES. All products are to be returned transportation prepaid by the buyer. Gould reserves the right to determine the cause and existence of a defect under this warranty and this warranty shall not apply to any products which have been subjected to misuse, improper installation, repair, alteration, neglect, accident, inundation, fire or operation outside their published maximum ratings.

THE FOREGOING WARRANTY IS EXCLUSIVE AND EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS AND OF ANY OTHER OBLIGATION AND SHALL CONSTITUTE THE SOLE REMEDY OF THE BUYER AND SOLE LIABILITY OF GOULD.

Gould offers an Extended Warranty Agreement for all its products, along with calibration traceable to NBS. Please contact the Service Center listed on the following pages for details before your warranty expires.

REPLACEMENT PARTS: Warranty is same as above except ninety (90) days from date of shipment.

If a defect occurs:

1. Notify your nearest Gould Service Center giving full details of the difficulty, and include the product model number, and serial number. On receipt of this information, service data or shipping instructions will be provided.

Compliance with the above procedure will assure the earliest repair and return of your equipment.

10-1-85

Gould instruments are individually tested and calibrated before shipment to assure dependability and verify their accuracy. To this procedure must be added an unseen ingredient of prime importance to you: The Gould concept of continuing service. Gould responsibility for each instrument sold covers far more than its delivery. Of equal concern is the equipment's suitability for its intended purpose, its correct installation, instruction of operating personnel -- plus future servicing and maintenance. The Gould Field Service Department offers customers any or all of these services:

Field Service

- o Installation
- o Field maintenance
- o NBS Certification

Training

- o Instruction of operators
- o On-site training seminars
- o Formal Training courses

Service Contracts

- o Fixed Fee
- o Time and Material
- o Extended Warranty

Our Seal of Pride Gould Inc., Recording Systems Division, and its predecessor organizations tracing back to Charles F. Brush, have been preeminent in instrumentation development since the 1920's. Among Gould's many achievements is a series of the world's best performing, most versatile, and reliable direct writing recording systems.

Today, Gould recorders and signal conditioners are the overwhelming choice for recording analog signals in the most critical industrial, scientific, and biophysical measurement applications. Whether recording the faintest life signals of a patient in a hospital operating room or the most critical variables in the lab or on the production line, you can depend on the accuracy, faithfulness, clarity, and permanence of the traces made by a Gould recorder.

Innovative design, coupled with highest quality, are hallmarks of all Gould products.

The Field Service Engineer Gould field service engineers provide on-the-spot assistance whenever and wherever it is required. While every field service engineer is the product of intensive and thorough factory training, you will find that his greatest strength evolves from field experience and his knowledge of your objectives. He is aware of your problems, is willing and able to assist you in their solution, and is backed by the nation's most experienced organization in recording instrumentation.

Our field service engineers and technicians are daily engaged in the installation, testing, maintenance, repair and inspection of Gould recording systems all over the country. They can provide you with any information about our instruments you may require; if not, they will find the answer to your problem.

Overhaul and Repair Because we service only our own products, our customers can feel confident of prompt, effective results when they turn to Gould Factory Service Centers.

The repair service these centers provide is of particular appeal to those companies that do not operate an instruments repair facility of their own. By designating the nearest Gould Service Center as its maintenance depot, a Gould-equipped company is assured the best chance for continuity of recording instrumentation.

Many companies with their own repair facilities find it more convenient and more truly economical to have their Gould equipment repaired by service contract with the closest Service Center. In addition to enjoying fast turn-around, these companies are spared the expense of carrying an inventory of recorder parts, accessories, and supplies.

Calibration and Certification A small, quiet room in the Standards and Calibration Section at the Gould plant in Cleveland contains precision reference standards just one step removed from the prime reference measurement standards of the United States – at the National Bureau of Standards in Washington. Included in this room which is temperature-controlled within one degree and has a constant relative humidity of 40%, are standards for voltage, frequency (derived from the atomic vibration of caesium), resistance, capacitance -- in fact all basic parameters of electrical measurement. The room is maintained under stabilized conditions 365 days a year.

The calibration practice of all Gould Service Centers is directly traceable to the National Bureau of Standards. We can supply complete calibration for any Gould equipment, and we can also certify to manufacturer's specifications followed by a letter of certification when required.

Training The Gould field service engineer will hold short training courses either on the job or at his facility. On-the-job training is usually a brief, informal session with the people who will actually be operating the Gould equipment.

Formal classroom training is more complete: detailed information, a thorough review of underlying theory, training devices, demonstration of problem solving and examination of students to determine their understanding and proficiency is accomplished at our Cleveland plant.

Contracts Customer companies requiring temporary or permanent service are afforded contract arrangements by which agreed-upon maintenance, repair, upgrading and calibration services are performed on a routine basis. Service contracts are now in effect with a number of customers, affording substantial savings in time and money.

Owing to the various requirements of each customer, we do not reproduce here a standard, boilerplate agreement -- which might contain too much or too little. Instead, we tailor each contract to a particular customer's needs. This practice has singlehandedly produced substantial savings in time and money for others; and it can do the same for you.

An extended warranty is available at the point of sale allowing a regulated budget for the first two years of ownership. You may take advantage of this warranty within the first year of ownership at a percentage of the current listed price.

SERVICE CENTERS

ATLANTA
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SECTION I

GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This manual is provided for operators of Gould 2800S Direct Writing Recorders. The manual contains Recorder Description, Specifications, and a Supplies and Accessories list. In addition, this manual also contains detail service and repair information including Theory of Operation, Installation Procedures, Operator's instructions, Routine Maintenance, and Illustrated Parts Breakdown (IPB). Instructions for preamplifiers which may be used with these recorders are contained in their own applicable manuals.

WARNING: IN PATIENT CARE APPLICATION, ISOLATION TRANSFORMER [GOULD P/N 882895-3 (115V), -4 (230V) OR EQUAL] MUST BE CONNECTED BETWEEN POWER SOURCE AND RECORDER.

1.2 DESCRIPTION

The Gould 2800S Direct Writing Recorder (Figure 1-1) features a high performance stepper motor and microprocessor (digital) control along with standard chart edge thermal annotation of all pertinent real time test data. The recorder is self-contained in a 380mm mainframe chassis and can accommodate 8 isolated recording channels. The recorder may be housed in a portable case or rack-mounted in a standard RETMA rack. (See Model Numbering Table for specific configuration.)

Incremental chart drive is a standard feature of the recorder. Its stepper motor and microprocessor (digital) control allows for quiet operation and chart speeds from 0.05mm/sec. to 200mm/sec. in 12 steps via front-panel pushbuttons or remote TTL inputs. The chart speed can also be varied continuously between steps with a front panel variable speed control or remote TTL pulse input.

Thermal Annotation (see note on page 2.4) records date, time, chart speed, test identification number and up to a 50 alphanumeric character user message. The on-board Real Time Clock setting can be changed as necessary or overridden by external IRIG-B time code feature (digital TTL, unmodulated). The RS232C interface allows information input through one of eight user-selectable 300 to 19,200 baud or manual rear panel hexadecimal thumbwheel switches. All information is retained in memory up to 72 hours during power off conditions by battery back-up. Waveform Recorder feature provides external trigger, memory and printout of Real Time to identify precise time triggered. Chart speed/date, time, and user message occur continuously, with 10mm spacing between, at all selectable fixed and variable speed settings.

NOTE: Thermal striped Kromekote "TSK" paper must be used (P/N 11-2987-300) for thermal annotations.

The Gould 2800S Recorder employs a pressurized fluid writing system. The system uses fast drying ink which is applied to specially coated chart paper. The ink is contained in disposable plastic cartridges which can be replaced in minutes. Two standard event markers are provided and are located between channels 1 and 2, and 7 and 8.

1.3 MODEL NUMBERING SYSTEM

The model number of the 2800S Direct Writing Recorder designates the number of recording channels, type of mounting, preamp cage as required, and operating voltages. Table 1-1 on page 1.8 describes the various models. Appropriate outline dimensional drawings follow the model numbering table.

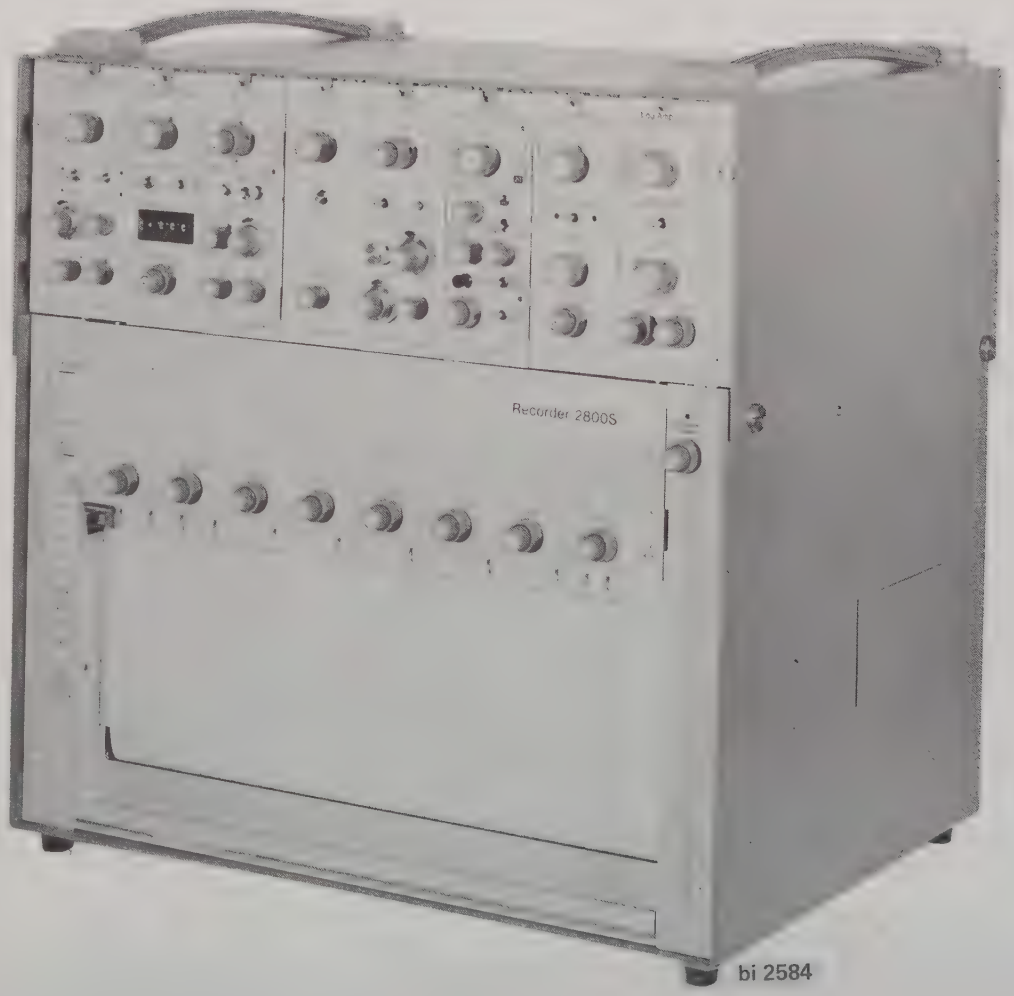


FIGURE 1-1 GOULD 2800S INK RECORDER

1.4 SPECIFICATIONS

1.4.1 General

Number of Analog Channels . . . . . Eight 40-mm (standard).

Number of Event Marker Channels . . . . . .Two.

Trace Presentation. . . . . .Rectilinear.

Trace Width. . . . . 0.01 nominal.

Marking Method . . . . . .Pressurized fluid (ink).

Marking Fluid Capacity. . . . . One-ounce replaceable, throw away cartridge.

Chart Speeds . . . . . .5, 10, 25, 50, 100 and 200 mm/sec. and divide-by-100. Selectable via front-panel pushbuttons or remotely via TTL or contact closure. Continuously variable via front-panel control or external pulse input.

Chart Speed Accuracy. . . . . ±0.25 @ 25° C ±10° C.

Chart Length. . . . . 275 ft. (94 mtrs) Kromekote. 400 ft (122 mtrs) reproducible.

Chart Width. . . . . .380 mm.

Divisions per Channel . . . . . 50 Divisions on 40mm channels.

Time Lines . . . . . One-mm by one-mm accentuated every 5mm and 100mm.

Chart Travel Direction. . . . . Top to bottom.

Paper Discharge. . . . . .Front.

Chart Wander . . . . . ±0.25mm.

Operating Temperature Range. . . . . 0° C to +50° C (+32° F to +122° F).

Storage Temperature Range . . . . . -40° C to +70° C (-40° F to +158° F).

Humidity. . . . . 95% @ 32° C (+90° F); Non-Condensing.

1.4.2 Electrical

Input Circuit. . . . . .Single-ended, floating (isolated from ground up to 500 VDC).

Input Impedance. . . . . .100 Kohm ±1% (recorder without preamps).

Input Signal. . . . . 5 volt span for 100 or 50mm channels.

Input Power . . . . . 100V, 115V, 200V and 230V ±10%, 50 to 400 Hz.

Power Consumption ..... (60W + 50W per channel).

Frequency Response ..... 100 div. @ 100 millimeter amplitude: dc to 30 Hz ±1 div.
50 div @ 50 millimeter amplitude: dc to 50 Hz ±1 div.
40 div @ 40 millimeter amplitude: dc to 55 Hz ±1 div.
10 div @ 10 millimeter amplitude: dc to 125 Hz ±1 div., down less than 3 dB @ 140 Hz.

Rise Time (10% to 90% full scale with less than 1% overshoot) ..... At 100mm amplitude: less than 8 msec.
At 50mm amplitude: less than 5 msec.
At 40mm amplitude: less than 4 msec.

Noise ..... 0.1mm peak-to-peak, R = 1 Kohm.

Non-Linearity ..... ±0.35% of full scale.

Pen Position Control ..... 270° rotation single turn potentiometer, one per channel.

Maximum Allowable Signal Input Voltage to Avoid Damage ..... ±50 Vdc or peak AC (recorder without preamplifiers).

Maximum Safe Common Mode Voltage ..... 500 Vdc or peak AC.

Common Mode Rejection Ratio ..... 60 dB @ 60 Hz (R = 1 Kohm, recorder w/o preamps).
80 dB @ dc (r = 1 Kohm, recorder w/o preamps).

Signal Limiters ..... Built-in adjustable and mechanical. (Limiters prevent pen damage from off-scale overloads).

Zero-Line Instability (Drift) ..... ±0.1% of full scale for 24 hours.
±0.025% of full scale per °C.
±0.1% of full scale for ±10% line voltage change.

Gain Instability ..... ±0.1% of reading for 24 hours.
±0.05% of reading per °C.
±0.5% of reading for ±10% line voltage change.

Remote Control Operation ..... All speeds selectable thru rear panel connector J-102 and are TTL compatible.

Internal Timer (Standard on all recorders) ..... Produces 40ms duration pulses at internally programmable repetition rates of: 0.1, 1, 10 and 100 sec. and 0.01, 0.1, 1 and 10 minutes.

External Pulse Speed Control ..... Chart speed is continuously variable via TTL pulse train. Frequencies of 0 to 20 KHz corresponds to chart speeds of 0 to 250mm/sec in a linear relationship.

External Pulse Input ..... 3 TTL Loads, minimum 10 μsec. Negative pulse width, 0-20 KHz. Stepping occurs on negative transition 79.8 pulses/mm.

Variable Speed Control ..... Continuously variable over a range of 2.5:1 down to next lower speed.

1.4.3 Thermal Annotation Specifications

Character Format . . . . . 5 x 7 dot matrix; 0.112 inch high; 10 characters per inch.

Character Set. . . . . ASCII upper case Hex 20-5F.

Maximum Chart Speed for Annotation . . . . . 200 mm/s.

Annotation Location. . . . . Left margin of chart.

Head Placement. . . . . Approximately channel time line.

Character Orientation . . . . . Horizontal, left to right, when viewed with right hand chart margin at bottom.

Resolution of Displayed Time. . . . . Nearest one second.

Speed Annotation Accuracy . . . . . In detent calibrate position, the exact speed selected will be printed. In uncalibrated variable speed mode, inaccuracy is less than 5%.

Operating Temperature . . . . . 0° C to +50° C, external to enclosure.

Storage Temperature. . . . . -40° C to +70° C.

User Inputs . . . . . Serial via RS232C, or parallel via Hex switches.

Battery Backup . . . . . Up to 72 hours without power after 24 hour charge.

Baud Rates . . . . . 300, 600, 1200, 2400, 9600, 14400 and 19200, internally selectable by DIP switches.

Printing Update. . . . . Continuous with approximately 10mm spacing between messages. Speed change will immediately result in reset.

Timing Mark . . . . . Printed before the time to indicate exact point corresponding to printed time.

1.4.4 Physical

Principle Dimensions. . . . . Refer to outline dimensional drawings following model numbering table.

Weight. . . . . 77.5 lb (34.9 Kg) Portable Case 12.5 lb (5.6 Kg) Portable case w/preamp cage 4.0 lb (1.8 Kg). Preamps 3.5 lb (1.6 Kg) each average.

Finish . . . . . Light and Dark Parchment.

1.5 SUPPLIES AND ACCESSORIES

1.5.1 Supplies

Chart Paper (All Models)

High Contrast, Kromekote (275 feet) 1mm time line

Eight 40mm channels (not perforated) 11-2983-31
Eight 40mm channels (semi-perforated with optical sensing marks and page numbers) 11-2983-301
Eight 40mm channels reproducible 11-2983-41
Eight 40mm channels thermal annotation paper for pressure ink recorder 11-2987-300

Analog Pen
(includes ink tube, lapping paper, and pen pressure adjustment wrench) 11-2823-35

Event Marker Pen 11-2873-20

Ink Tube (Event Marker Pen) 667447-1

Ink Cartridge (1 oz. Blue Ink) 11-2730-01

Gram Gage 240601-910

Plug, Signal Input, P-201 (shipped loose with recorder) 114816-15

Plug, Monitor, P-202 (shipped loose with recorder) 289046

Connector, P-102 (shipped loose with recorder) 245537

Battery, Backup (Annotation) 696815

1.5.2 Accessories

Pocket Termainl, RS-232C 11-2403-14

CRT Terminal 23-2101-21

Cable RS232 for use with CRT Terminal 369500-73002

Starter Kits

Starter kits include 12 rolls of high contrast chart paper, gram gage, one analog pen, lapping paper and pen pressure adjustment wrench. Below are starter kit model numbers.

Eight 40mm channels (non-perforated) 11-6250-32
Eight 40mm (semi-perforated) 11-6250-36
Eight 40mm (semi-perforated) for thermal annotation 11-6250-45

Blank Amplifier Module 13-4615-09

Blank Amplifier Panel 887005

Fuse Kits

115V, 50-400 Hz. 694921-00
100V, 50-400 Hz. 694921-01
230V, 50-400 Hz. 694921-06
200V, 50-400 Hz. 694921-07

Drive Amplifier Extender Card 887526

Pen Pressure Adjustment Wrench 1-120922-18

Band, Penmotor 684999

Ink Tube Replacement Tool 267528

Rack Mounting Kits (for conversion of portable units)

2800S Recorder with Preamp Cage 11-1202-14
2800S Recorder without Preamp Cage 11-1202-15

Mobile Carts 11-6405-02

Chart Take-up 11-6402-12

Interchannel Event Marker (includes pen when ordered with recorder). 11-2123-37

Thermal Annotation Kit (available for those recorders purchased from September, 1983 to January, 1984 that do not have Annotation) 11-2123-51

500 Watt Portable Isolation Transformer (for patient care applications) 882895-3 (115VAC)
882895-4 (230VAC)

TABLE 1-1 2800S SERIES MODEL NUMBERING SYSTEM

2107-XXXX-XX

Operating Voltages

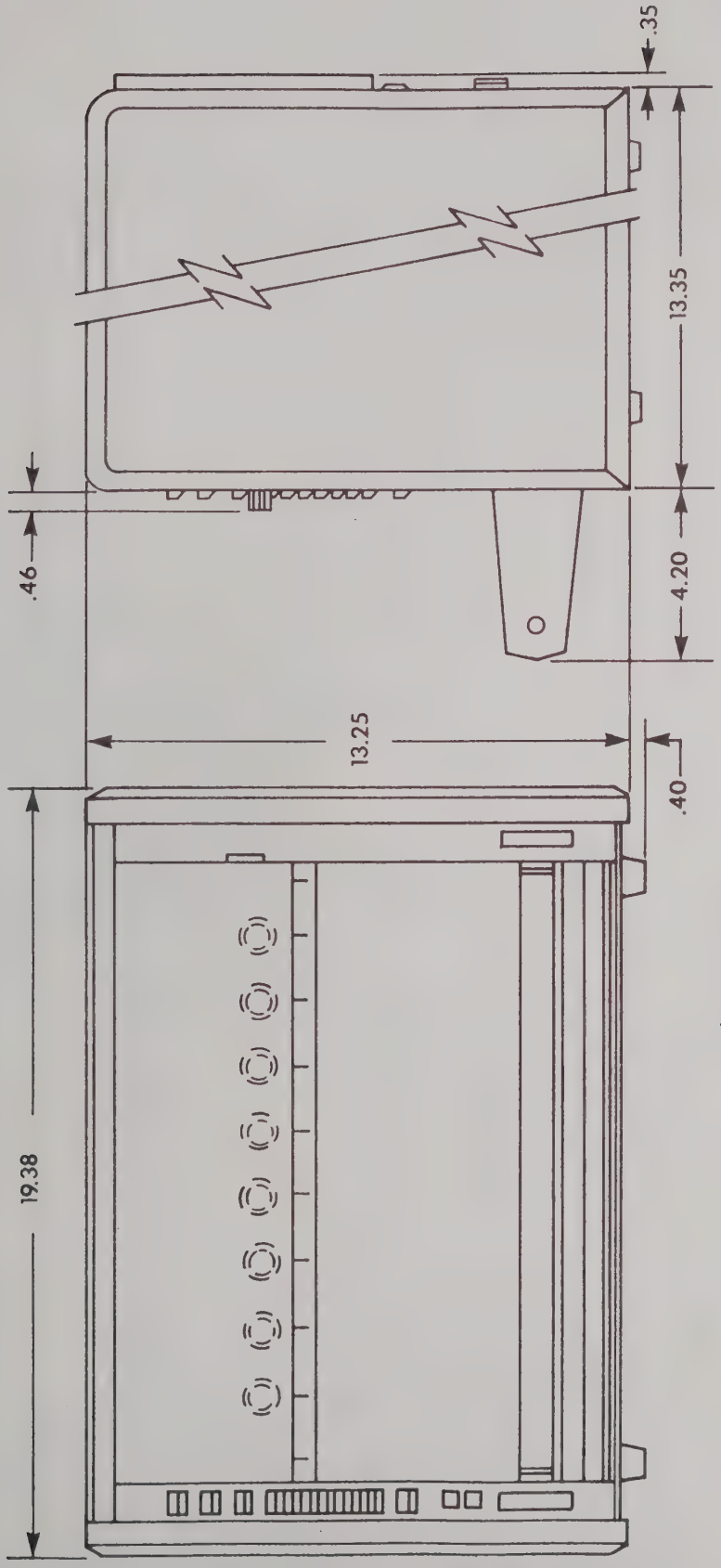
00	115 Vac, ±10%, 50-400 Hz
01	100 Vac, ±10%, 50-400 Hz
06	230 Vac, ±10%, 50-400 Hz
07	200 Vac, ±10%, 50-400 Hz

Type of Mounting and Preamplifier Cage and Frame Configuration

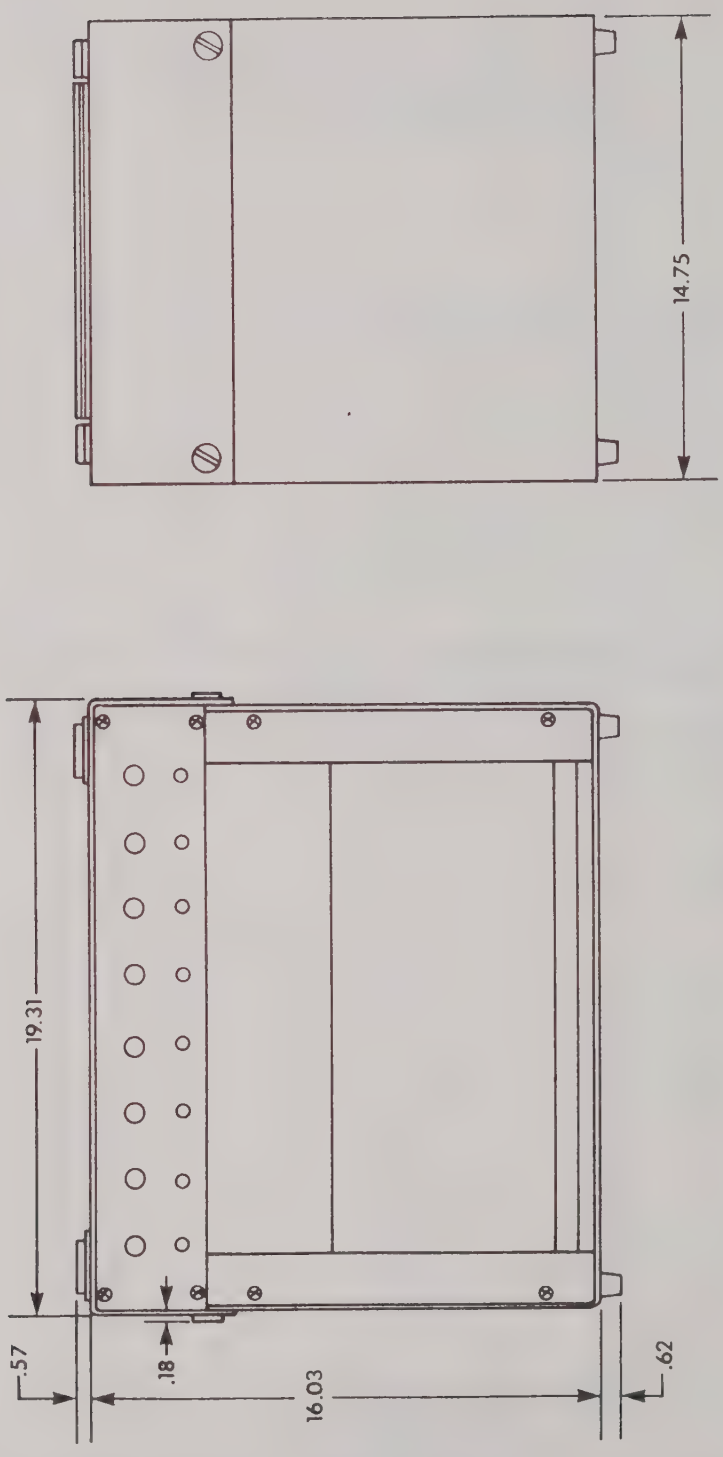
00	Portable case with recorder only
01	Portable case with top mounted preamp cage (flip-top)
09	Portable case with 50mV preamps
48	Rack mounting kit, 8 channel preamp frame for 4600 Series preamp, vertical cabinet and ac power kit
49	Rack mounting kit, 8 channel 50mV preamps, vertical cabinet and ac power kit
68	Rack mounting kit, 8 channel preamp frame for 4600 Series preamps, vertical cabinet and 30 microampere isolated power kit
70	Rack mounting kit, recorder only
78	Rack mounting kit, 8 channel preamp frame for 4600 Series preamps
79	Rack mounting kit, 8 channel preamp frame for 4600 Series preamps, vertical cabinet and ac power kit

Number of Channels

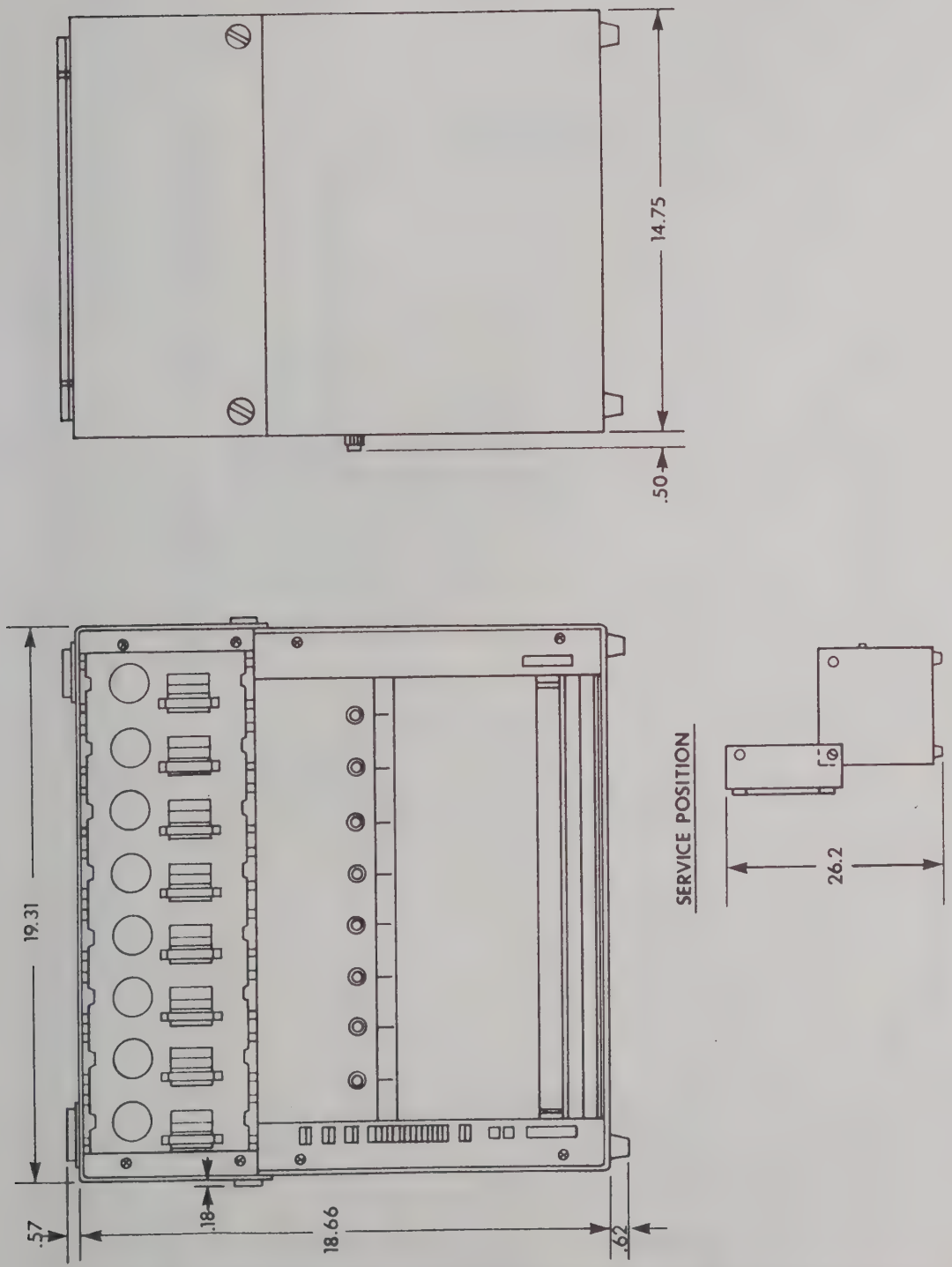
88	Eight 40mm channels, chassis assembly, drive amplifiers and timer



OUTLINE DIMENSIONS - 2800S RECORDER
FIGURE 1-2



OUTLINE DIMENSIONS - 2800S RECORDER w/50mV PREAMP PANEL
FIGURE 1-3



OUTLINE DIMENSIONS - 2800S RECORDER W/TOP MOUNTED PREAMP CAGE
FIGURE 1-4

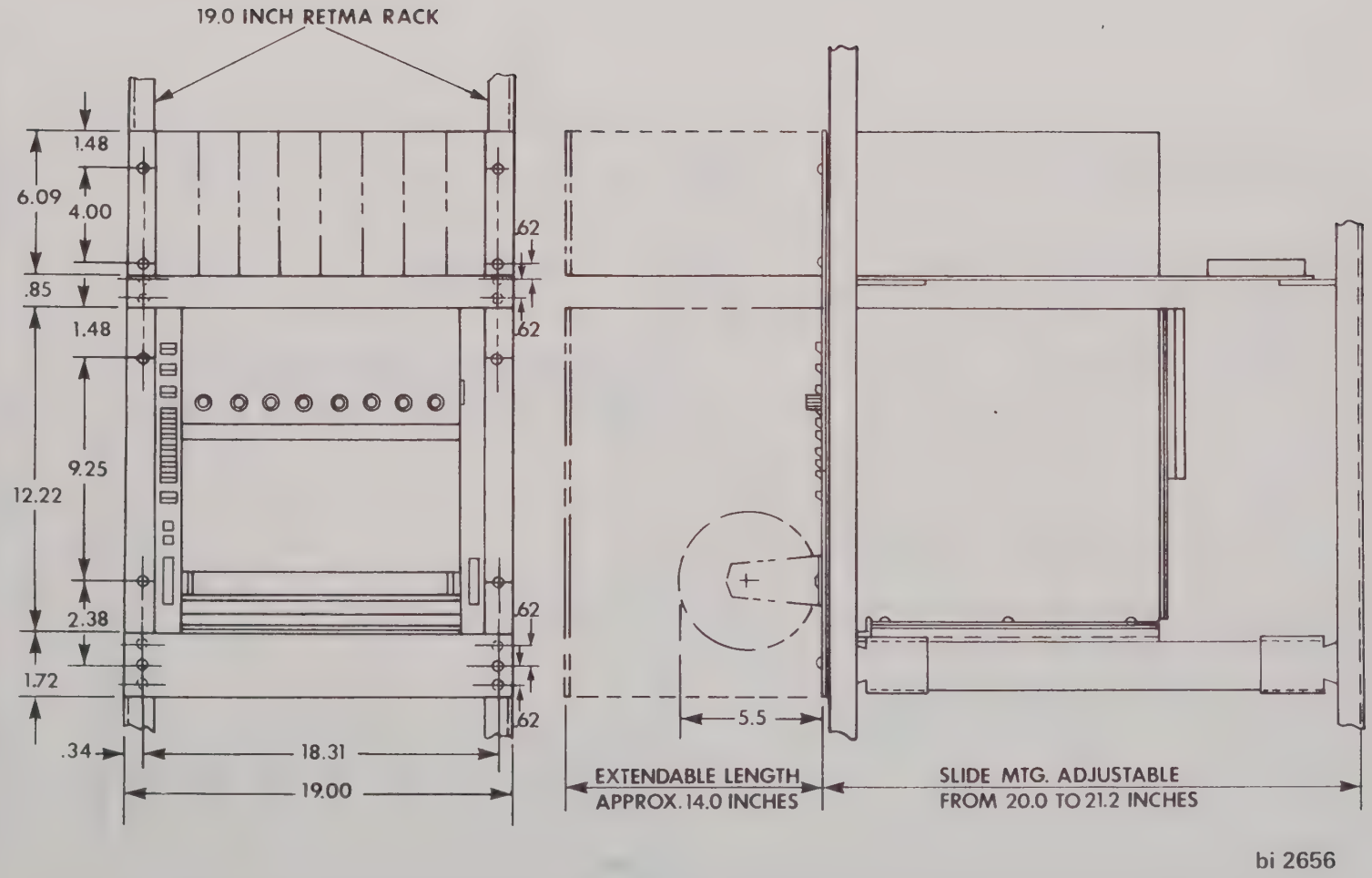


FIGURE 1-5 OUTLINE DIMENSIONS 2800S RECORDER RACK MOUNTABLE

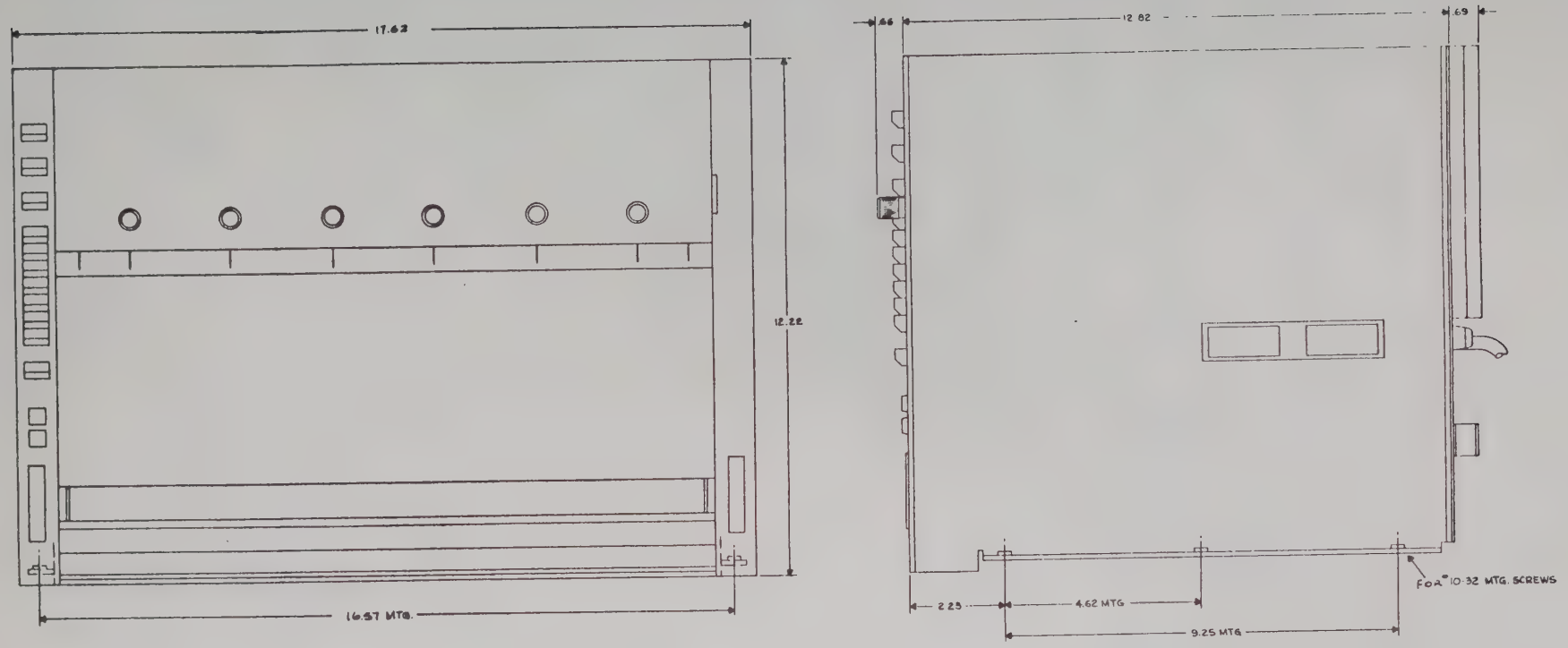


FIGURE 1-6 OUTLINE DIMENSIONS – RECORDER ONLY

SECTION II

INSTALLATION

2.1 GENERAL

This section contains information necessary to put the recorder into service, including installation of optional equipment.

2.2 SERVICE UPON RECEIPT

CAUTION: POWER MUST BE OFF DURING THE FOLLOWING SEQUENCE.

Before making signal connections and applying power to the recorder, the following service must be performed:

1. Remove sheet of chart paper from under pens and load roll of chart paper as described in Section V.

2. Slide all manual ink valves with tubing attached to ON position. (Follow direction of arrows on manifold bar.) Valves are located on top of recorder. Remove the recorder top front cover to gain access to valves. Slide cover forward and lift out. (If recorder is rack mounted, slide recorder out of rack.)

3. Ink cartridge and ink solenoid valve are turned on prior to shipment from factory.

NOTE: Ink cartridge should be near full.

4. Place cover back in position (or slide recorder back into rack and secure).

2.3 LINE VOLTAGE REQUIREMENTS

The last digit of the model number designates line voltage. Frequency range for all models is 50-400Hz. Listed below is last digit of model number and required line voltage.

DIGIT	LINE VOLTAGE
0	115 Vac
1	100 Vac
6	230 Vac
7	200 Vac

CAUTION: MAKE SURE A.C. JUMPER BOARD IS IN CORRECT POSITION (PARA. 2.9).

2.4 ANALOG SIGNAL CONNECTIONS

2.4.1 Without Preamplifiers

On recorders not supplied with preamplifiers, signal input connections are made directly to pen drive amplifiers. Two phone jacks are provided on each drive amplifier. They are located on the rear of the recorder (Figure 2-1). Use shielded cable (Belden 8422 or equal) with mating phone plugs provided. Tips are high; rings are low; barrels are common.

2.4.2 With Preamplifiers

On recorders supplied with preamplifiers, signal input connections are made via a connector located in the preamplifier cage. Refer to applicable preamplifier manual for their signal input connections.

2.5 EVENT MARKER INPUTS

2.5.1 Standard Event Markers

Left and right markers are standard. Actuation is made by momentary switches on front panel or externally via the terminal strip located on recorder rear panel. External actuation may be made by contact closure or TTL signal input. Refer to Figure 2-2 for connections.

2.5.2 Optional Event Marker

Interchannel optional event marker is actuated by a contact closure via the rear panel terminal strip. Refer to Figure 2-2 for connections.

2.6 REMOTE CHART DRIVE (Stop/Start)

For remote chart drive operation, remove jumper between terminals 3 and 4 on rear panel terminal strip. Front Panel speeds are disabled during remote operation. A contact closure across these pins will "remote enable" chart drive motor. Refer to Figure 2-2. Chart SPEED must be pre-selected. Remote Start/Stop operation, as well as speed control, can also be operated via J-102 covered in para. 3.8.

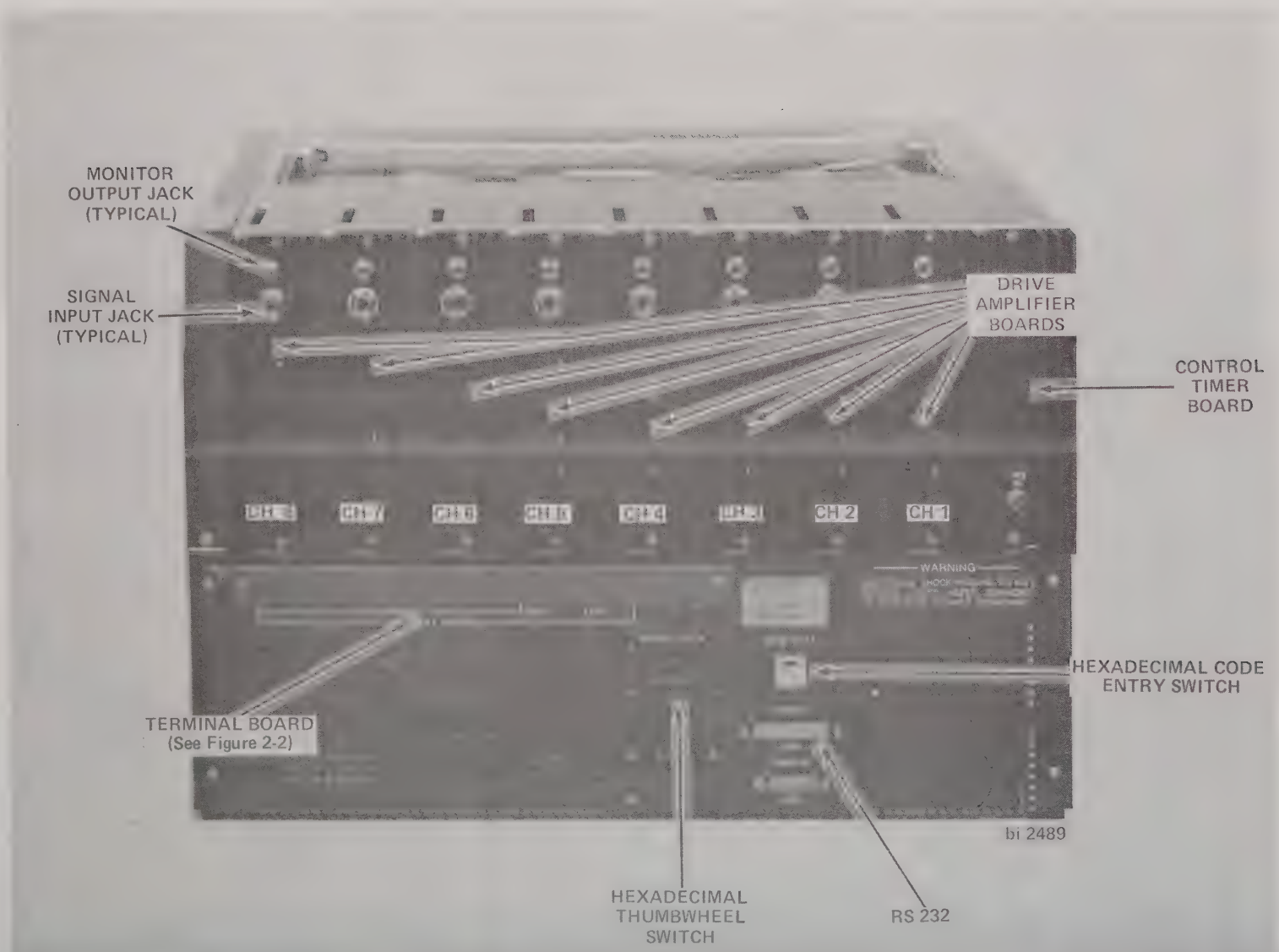


FIGURE 2-1 SIGNAL INPUT CONNECTIONS
(2800 VERSION SHOWN)

2.7 CHART TAKE-UP INSTALLATION

Refer to Figure 2-3, and install the optional chart take-up as follows:

1. Disconnect recorder from power source.
2. Remove case from recorder as described in para. 5.3.6 (or slide recorder about 6 inches out of rack).
3. Remove plastic caps covering slots in front panel.
4. Position chart take-up on front panel with drive belt on left side. Secure with screws and lockwashers.
5. Slide pulley onto drive roll shaft, and secure with cotter pin.
6. Position drive belt over pulley.
7. Reinstall case.

2.8 RACK MOUNTING KITS

Rack mounting kit for recorder without preamps is Model 11-1202-17; for recorder with preamps use Model 11-1202-16. Installation instructions are included with each kit.

2.9 A.C. JUMPER BOARD

WARNING: REMOVE POWER SOURCE.

If it becomes desirable to operate the recorder at some voltage other than the specified one, the A.C. Jumper Board (Figure 2-4) must be repositioned, and the fuses replaced.

The A.C. Jumper Board is located behind the writing table. To gain access to the board, open the table and remove the chart paper roll (para. 5.2.1). The board will immediately become visible when looking into the recorder. The voltage the unit is set to operate at appears on the left side of the board.

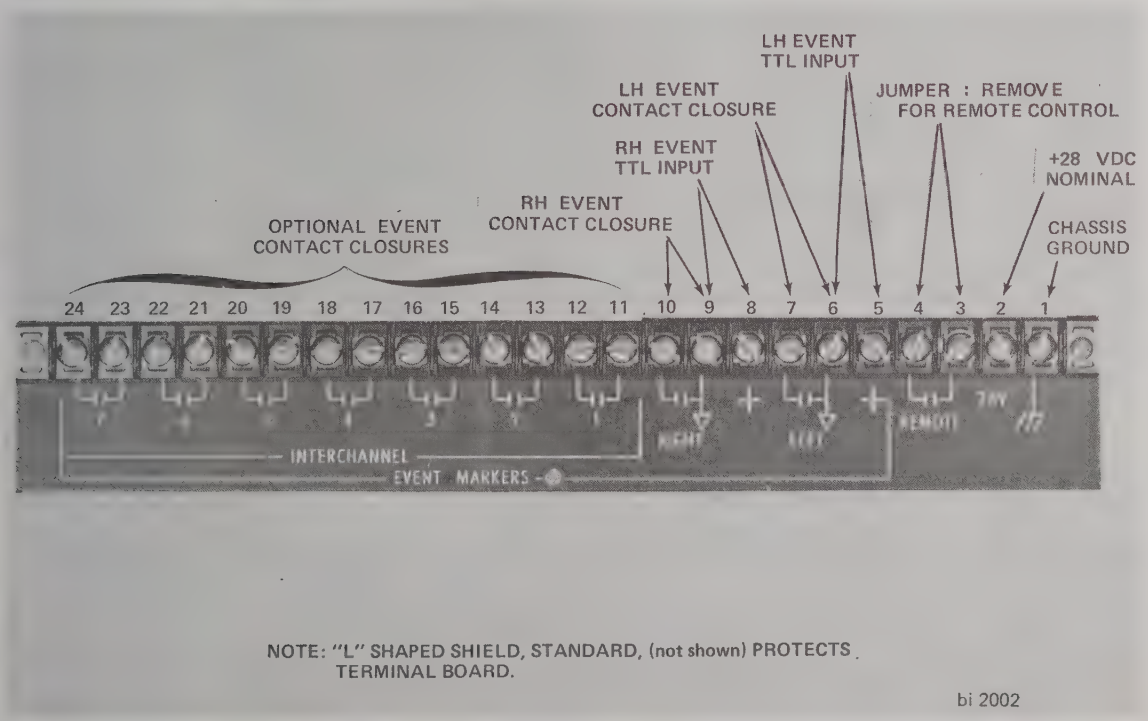

LH EVENT TTL INPUT
LH EVENT CONTACT CLOSURE
JUMPER : REMOVE FOR REMOTE CONTROL
RH EVENT TTL INPUT
+28 VDC NOMINAL
RH EVENT CONTACT CLOSURE
OPTIONAL EVENT CONTACT CLOSURES
CHASSIS GROUND
24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
INTERCHANNEL EVENT MARKERS
NOTE: "L" SHAPED SHIELD, STANDARD, (not shown) PROTECTS TERMINAL BOARD.
bi 2002

FIGURE 2-2 REAR PANEL TERMINAL CONNECTIONS

The procedure that follows describes repositioning the A.C. Jumper Board.

1. Carefully place screwdriver blade between "EAR" of board and "CONNECTOR" and pry board upward from connector, first from one "EAR", then the other (See Figure 2-4).
2. Remove board from recorder once loosened. Select desired voltage, reading voltage number on left side of board (facing reader).
3. Place board back into connector making sure it is seated correctly.
4. Install appropriate fuses on Control Timer board (see Figure 2-1). Refer to Tables 5-1 and 6-1 for options.
5. Replace chart paper roll and close writing table. Refer to Section III, Operation, before attempting to operate recorder.

2.10 THERMAL ANNOTATION

NOTE: Some recorders purchased from September, 1983 to January, 1984 may not have Thermal Annotation. This feature may be purchased separately and installed on recorders with serial numbers starting at 2000. The Thermal Annotation Kit 11-2123-51 may be ordered through an authorized Gould Service Center. Installation by other than qualified Gould Service Engineers may void warranty.

Refer to Section III, Operation.

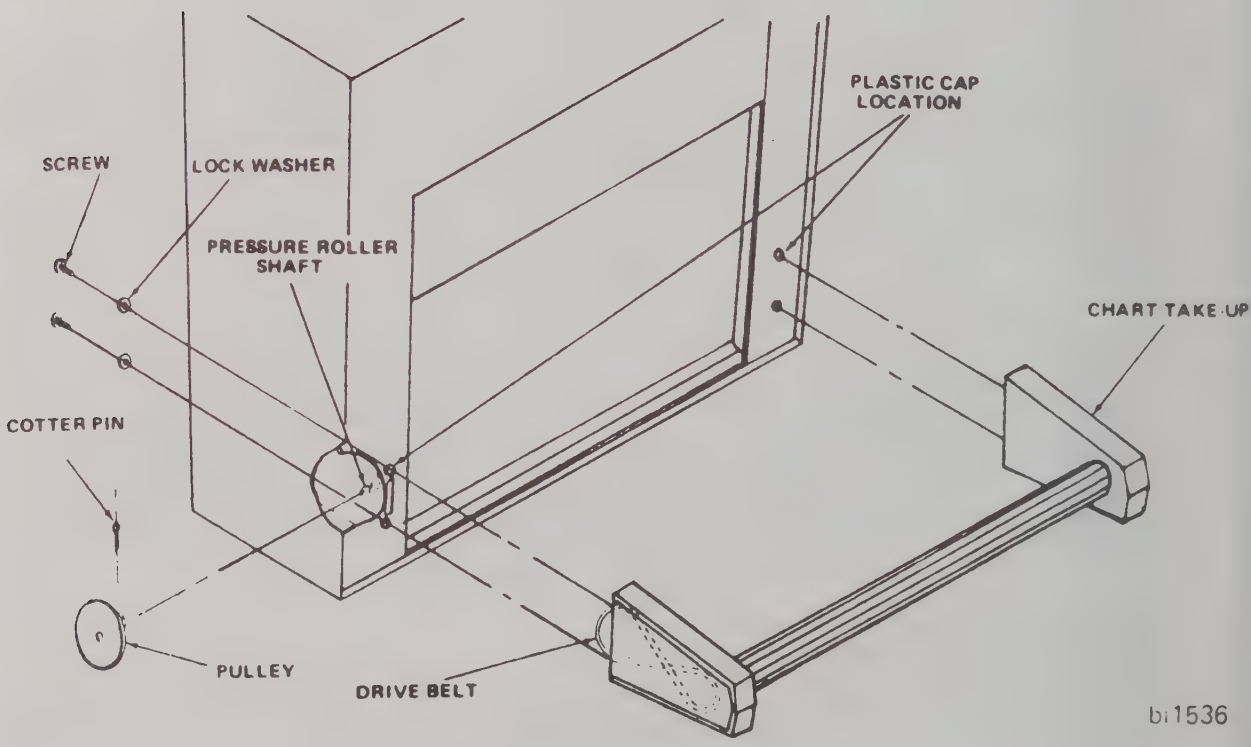
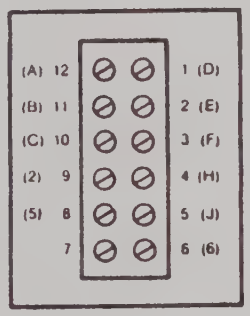


FIGURE 2-3 CHART TAKE-UP INSTALLATION

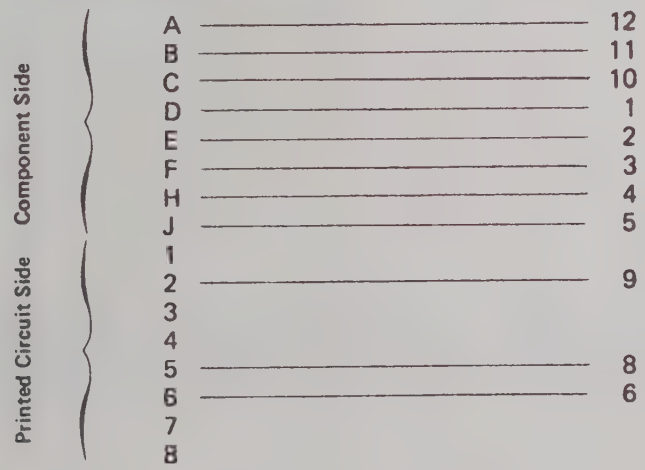


(CARD EDGE CONNECTIONS ARE IN PARENTHESIS)

SPADE LUG TERMINAL BOARD FROM PORTABLE CARRYING CASE

AMPLIFIER 16-PIN CARD EDGE CONNECTOR

SPADE LUG TERMINAL BOARD PORTABLE CASES/RECORDERS & BIOPHYSICAL SCOPES



PORTABLE 2000S SERIES INPUT/OUTPUT CONNECTIONS TO 4600 SERIES AMPLIFIERS
FIGURE 2-5

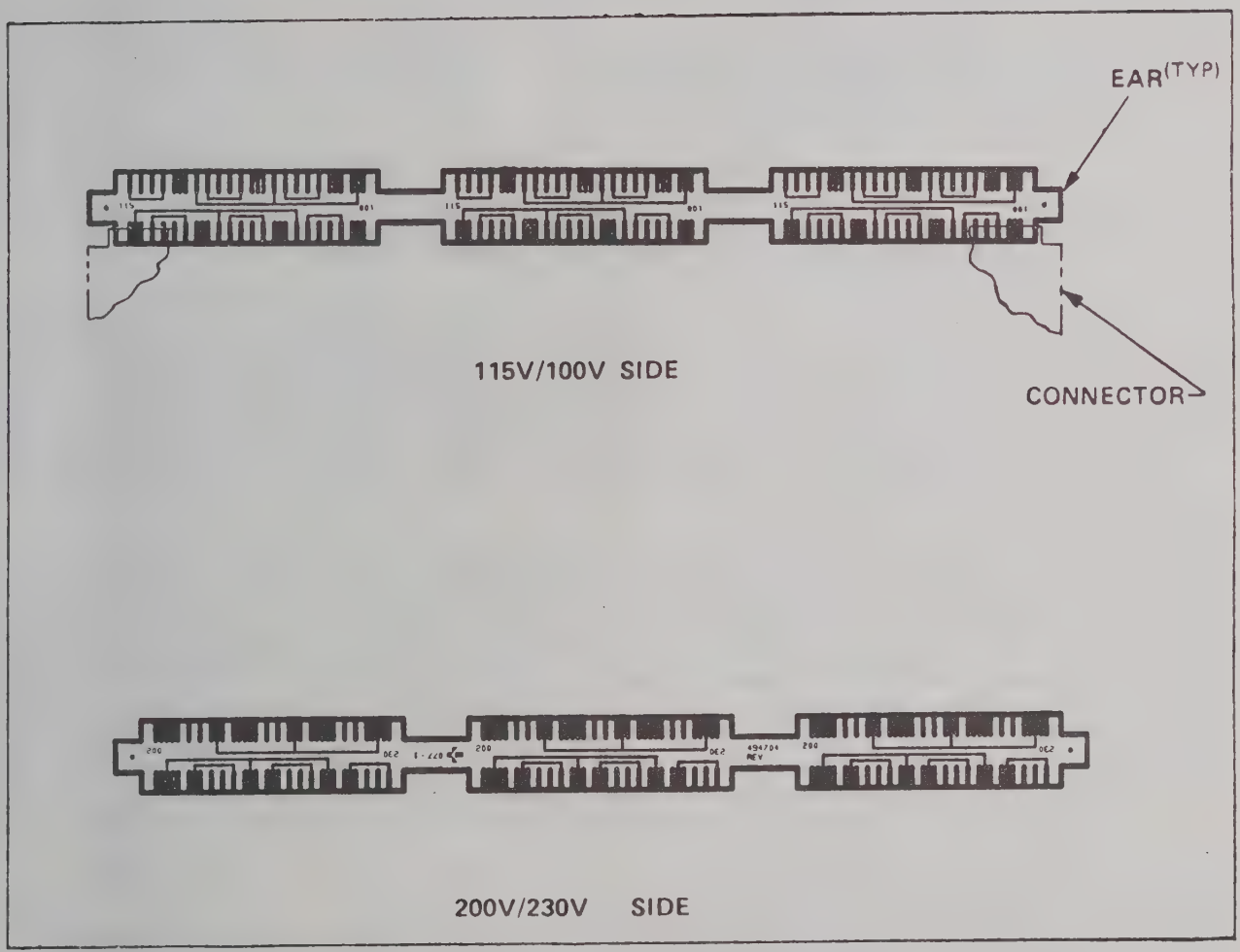


FIGURE 2-4 A.C. JUMPER BOARD

2.11 STACK-TO-STACK INSTALLATION (OPTION)(THERMAL RECORDERS ONLY)

In addition to the Takeup Drawer and Supply Compartment assemblies and the set of slides and hardware which mount them, the Stack-to-Stack Kit Assembly includes a few parts to be assembled to the associated 6 or 8 channel rack mounted recorder as detailed here:

CAUTION: BE SURE RECORDER IS DISCONNECTED FROM POWER SOURCE - NOT JUST TURNED OFF AT THE PANEL!

1. Remove and discard the 1.75 inch high front panel normally used just below the paper exit on the recorder (including two panel screws). (Part of Recorder Rack Mount Kit 11-1202-14 when ordered separately.)

2. Unscrew and temporarily remove the panel type screw(s) clamping the left and right recorder slides (centered on each slide about 1-1/4 inches back of the former panel location - see Kit Assembly detail, view A-A). The recorder can now be extended to allow better access for the next two steps.

3. Item no. 8 (Pressure Defeat Assembly), is mounted to the inner R.H. sideplate as shown in its detail, view C-C, between the two stop pins. If it is oriented with the smaller tab and lip pointed down when the pin is placed in the hole provided, the pressure arm extending thru the slot does not have to be held back while inserting the pin. Press item no. 6 (External Retaining Ring) on to the pin extending outside of the R.H. recorder sideplate.

4. Peel the backing off the self-adhering label (item no. 20) and attach it to the inside of the R.H. sideplate above and parallel to the slot as shown in the detail, view C-C, of the Installation Drawing.

5. Hold the recorder paper tension arm (extending through the long slot) toward the back of the recorder while rotating the pressure defeat arm into the Fan-Fold position indicated on the label.

6. Mount the spacer bars (items 11) to the left and right front rails using flat head screws (item 17) and nut plates (item 5). **NOTE: Mount spacer bars to the front of the rack rails with the countersinks out (ignore three extra holes near center of the spacer bars - not used).**

   The bottom nut plates, behind the rails, are used to clamp the fingers on the Takeup Drawer slide brackets and should not be tightened at this time. Only two countersunk spacer bar holes are used for the flat head screws mounting each nut plate. Center hole in nut plate is for the panel thumbscrew. Four short spacer bars may be found in some kits, replacing the two long bars. This makes panel alignment easier.

7. Assemble a nut plate (item 5) to the inside of each rear rack rail at the same height as for the lower nut plate on each front rail spacer (used to support the Takeup Drawer slides). This time, use the four pan head screws (item 18), lockwashers (item 21) and washers (item 22). Do not tighten yet (will be disassembled to mount Takeup Drawer slides).

CAUTION: FOR SAFETY REASONS, IT IS HIGHLY ADVISABLE TO UNSCREW AND REMOVE THE HEAVY RECORDER FROM THE RACK MOUNTING SADDLE (FOUR SCREWS) BEFORE ATTACHING THE BRACKETS WHICH MOUNT THE PAPER SUPPLY ASSEMBLY TO THE RACK MOUNT SLIDES AND THEN PROCEED TO STEP 8. THE RECORDER MUST BE REMOVED IF WORKING WITH THE RECORDER EXTENDED ON THE SLIDES.

8. Next, attach the "U" shaped brackets (item 9) to the bottom of the recorder rack mount's saddle plate, using the same six screws that hold the plate to the slides. The brackets are interchangeable as long as the slotted holes are on the bottom and the bracket open edges face each other, i.e., [-----].

9. Reposition the recorder into the rack and replace the panel type screws clamping the slides (view A-A) to lock the recorder in position.

10. Item No. 4 (Transformer Cover Assembly) mounts to the front lip of the slide mounted saddle supporting the recorder. The protective "grommet strip", (item 31) is supplied to prevent wiring damage. Press strip in place across the entire edge of item 4 as shown. The three studs at the BOTTOM edge of the shield match up with the three holes in the recorder support saddle lip just in front of the transformers and power distribution board. Fasten with Item No. 16 (Nut Assembly).

11. The hinged panel of the Supply Assembly overlaps the recorder slide area where the 1.75 inch panel was located and a total of 10.5 inches of empty rack is required below the rack mounted recorder, in addition to the overlapped area.

12. Slide the Supply compartment assembly item 2 between the brackets (item 9) from the front of the rack and allow four no. 6 studs on the bottom to drop through the slots provided. Fasten securely using Nut Assemblies (item 12).

13. Loosen the three nuts holding the Supply Front Panel slightly. This may require an end wrench. Then close the hinged panel and center it in the opening. The panel thumbscrews should thread easily into the spacer bars. If not, it will be necessary to reposition the spacer bars slightly. Retighten the three nuts holding the panel with the panel centered. Check that the panel lies flat against both rack rail spacers. This can be adjusted by loosening the three no. 10 nuts holding the L-shaped bracket under the tray. Tighten nuts.

14. Open the recorder, as if to load roll paper. Remove the double-flanged roll paper mandrel and set aside any unused roll paper. Replace the roll with the new paper core provided in the Kit (item 7). Inspect the mandrel flanges to make sure they are not bent or damaged. Do not compress the core tube unduly by screwing on the flange too tightly. Reinsert the mandrel with the notched end of the core tube to the left. Snap the release lever into the locked position.

15. The set of slides (item 10), used for the Takeup Drawer (item 3), detent in the "out" position. Assemble the end brackets to both slides if there are not already attached. Use packaged hardware supplied. The rear bracket has a long adjustment slot. Extend the slide fully. One end has two holes spaced 1/2 inch apart. Mount the rear bracket, using these holes, to the outside smooth slide surface with the lockwashers, washers and nuts on the outside. The screw holes for the front bracket are accessed through a 1/2 inch hole in the moving slide (extend slide fully).

16. Each slide mounts between a front and rear rack rail and is clamped by the lowest nut bars. By adjusting the slotted rear brackets, match the front to rear rail spacing. Note that the left slide, as viewed from the front of the rack, has the welded-on angle bracket as a normal "L" (not upside down). Set the slide to slide spacing to match the slide flange hole spacing to the 14.34 inch spacing of the studs protruding from the bottom of the Takeup Drawer (item 3). Mount the drawer and panel subassembly in place and fasten with Nut Assemblies (item 12). Then hold up the drawer panel to align properly in the rack and tighten the slide mounting screws. Test that the drawer slides in and out without binding and that the panel thumbscrews thread easily. The spacer bars may need to be repositioned slightly. Occasionally it is necessary to run a no. 10-32 tap through the nut bar threaded hole to ease thumbscrew operation.

17. Load and thread paper per the diagram on the hinged Supply Drawer door and/or consult the Operating Manual for further details. Observe proper orientation of the paper stack in the Supply Drawer so that Channel 1 is to the left and the grid lines will face out.

18. In use the Takeup Drawer is in the detented "out" position. The asymmetrical "W" shaped paper tray is placed in the drawer with the front labelled side against the pierced out stop tabs. Make sure the paper folds in the tray with the same bend direction at each fold as in the supply stack.

19. Attach adhesive Label (item 19) to the rear panel of the Supply Drawer, as shown in view D-D, for Model and Serial No. Identification.

20. The Paper Supply Compartment may have to be adjusted to allow the paper to track properly at all speeds. Six no. 10 nuts on the underside of the supply drawer are loosened to allow the compartment to slide left and right on the subassembly plate to which it is mounted. The compartment is moved to the right in increments until a slight dragging of the paper against the left mandrel flange is detected at 100 mm/sec chart speed, then backed off slightly. Paper position will normally remain within 1/2 mm of the same position with roll or stack operation and the left event marker trace should stay within 1/2 mm of the same location for 10, 25, 50, 100 and 200 mm chart speeds. The paper should track with its left edge within 1/16 in. of the black alignment mark on the writing table. Black writing paper is more critical on this setting than blue writing. Retighten the six nuts loosened previously.

2.12 Recorder Rack Mount Kit Installation Instructions (11-1202-14)

Refer to Figure 6-9 when using the following instructions.

a. Assemble brackets Items 8 & 17 to slides Item 7 using lockwashers Item 10, washers Item 13 and nuts Item 15. (These items may be assembled.)

b. Mount slide assemblies from Step a and spacers Item 6 to front rail of the cabinet using nut plate Item 4 and screws Item 14, and to rear rail of the cabinet using nut plate Item 4, lockwashers Item 11, and screws Item 12.

c. Attach filler panel Item 9 to spacers Item 6 using nut plate Item 4 and screws Item 18.

d. Attach saddle assembly Item 3 to bracket of slides Item 7 using screws Item 19. (Leave screws loose.)

e. Mount recorder assembly Items 1, 2, 25, or 26 onto saddle assembly Item 3 using Items 11, 27 & 29. (Leave screws loose.) Slide recorder assembly into cabinet making sure slides are all the way into the rear of the cabinet. Lock slides using screws Item 18. Adjust recorder and saddle until front panels of the recorder are aligned with the filler panels Item 9. Tighten all the screws left loose in Steps d & e.

f. Attach panel Item 5 to spacers Item 6 using screws Item 18.

g. Refer to Figure 6-9 and the following steps for installation of plugs into connectors J-103 & J-104 of the recorder.

Step 1: Remove the two screws that fasten cover (A), Part No. 287599, to rear of side plate. Discard the cover and screws.

Step 2: Remove two screws and one nut that fasten shield (B), Part No. 296177, and remove the shield.

Step 3: Route the harness from other accessories containing plugs labeled (P-103 & P-104) or (1 & 2) through notch (C) in the flange at the rear of the right hand side plate.

Step 4: Route the harness through cable clamp (D).

Step 5: Connect the harness plugs (P-104 or 2) to J-104 and (P-103 or 1) to J-103.

Step 6: Attach ground wire from harness to hole (E) using screw Item 21.

Step 7: Replace shield (B) using two screws and one nut removed in Step 2.

h. Use clamp Item 22 (not shown) to fasten power cords to saddle assembly. (Loop cord twice through clamp to prevent cord from pulling out of connector.)

i. Use clamps Item 24 (not shown) to fasten the power cords to the wall of the cabinet.

2.13 RACK MOUNT INSTALLATION INSTRUCTIONS, RECORDER ONLY

Refer to Figure 6-8 when using the following instructions.

To avoid damage during shipment your recorder has been shipped separately from its rack mount enclosure. As an aid in installing the recorder, complete mechanical and wiring instructions are provided below.

I MECHANICAL

A. Remove panel, item 5, held on by two screws, item 18 (see figure).

B. There are two more item 18, screws, used to lock the slides. These screws are accessible after panel item 5 is removed; they go sideways through the slides, near the front as shown. Remove them and pull the slides and recorder saddle forward.

WARNING: When recorder is to be installed in the cabinet assembly, lock casters with FOOT PEDAL lock prior to installation.

C. Place recorder on RECORDER SADDLE. Align 4 holes in recorder with 4 holes in RECORDER SADDLE (see figure). Attach recorder to RECORDER SADDLE using items 11, 27 & 29 (no. 10 LOCKWASHER, PLAIN WASHER, and SCREW, 4 sets).

D. After the wiring instructions (below) have been satisfied slide recorder back into enclosure. Lock the slides in place using the two screws removed in step B and then replace the panel, item 5.

II WIRING

A. Power Cord

1. Insert recorder power cord plug into appropriate voltage source if hook up is direct.

2. If enclosure is equipped with panel power strip, insert recorder power cord plug into one of its outlets.

3. If the enclosure is equipped with a power kit, the 3 leads from the recorder power cord mate with TB 1 of the connector panel assembly. The connector panel assembly is located on the rear panel of the enclosure near the base (see figure). The leads (with staked contacts) are mated with TB 1 as follows:

BROWN or BLACK - terminal 6
BLUE or WHITE - terminal 7
GREEN/YELLOW or GREEN - terminal 8

NOTE: Lead colors may differ on specials. Match power cord colors with TB 1 if this is the case.

4. Fasten power cords to saddle assembly and the wall of the cabinet. Loop cord twice through clamp to prevent cord from pulling out of connector.

B. Preamp Cage Connectors

Step 1 Remove the two screws that fasten cover (A), Part No. 287599, to rear of side plate. Discard the cover and screws.

Step 2 Remove two screws and one nut that fasten shield (B), Part No. 296177, and remove the shield.

Step 3 Route the harness from other accessories containing plugs labeled (P-103 & P-104) or (1 & 2) through notch (C) in the flange at the rear of the right hand side plate.

Step 4 Route the harness through cable clamp (D).

Step 5 Connect the harness plugs (P-104 or 2) to J-104 and (P-103 or 1) to J-103.

Step 6 Attach ground wire from harness to hole (E) using screw, item 21 (see figure).

Step 7 Replace shield (B) using two screws and one nut removed in Step 2.

C. If configuration requires cables connecting jacks on the recorder drive amp cards and preamp input connectors, the cables will be tagged at either end with numerals representing channel numbers. Make connections per these markings. The cables will be secured within the enclosure at a convenient location.

SECTION III

OPERATION

3.1 GENERAL

This section provides complete instructions for operation of the recorder. Functional descriptions of the controls and indicators are provided. If the recorder is equipped with preamplifiers, refer to their applicable instruction manuals for operating instructions.

CAUTION: NEVER APPLY POWER TO RECORDER WITH POWER BUTTON IN "ON" POSITION.

3.2 FRONT PANEL CONTROLS & INDICATORS

Figure 3-1 illustrates the front panel controls and indicators. The list that follows corresponds to the items called out on Figure 3-1.

ITEM	CONTROL	DESCRIPTION
1	POWER SWITCH/ POWER LAMP	Controls AC to recorder. Depress to turn recorder ON or OFF. POWER lamp is lighted when recorder is ON.
2	CHART SPEED SELECTION	Permits selection of six calibrated chart speeds of 5, 10, 25, 50, 100 and 200 mm/second and STOP. When in STOP position chart drive is off, and pens will not respond to input signals. Depressing any chart speed button will activate the chart drive at the selected speed. Chart speeds may be changed while chart drive is running. However, during remote** operation all front panel controls are disabled except for power On/Off pushbutton.
3	DIVIDE BY SWITCH	When depressed, chart speed will be divided by 60, 100 or 1000 depending upon internal processor board DIP switch ÷ speed selection. (Para. 3.4).
4	*VARIABLE SPEED CONTROL	Single turn potentiometer with 270° rotation. Provides continuously variable speeds between calibrated selected chart speed, and overlapping next lower calibrated speed. When control is at full CW (calibrated detent) position (x1), chart speed matches selected speed. As control is rotated CCW chart speed is reduced. When rotated full CCW uncalibrated speed is reduced 2.5 times and will be slower than next lower calibrated speed. If optional Annotation is activated, exact uncalibrated speed can be annotated with less than 5% inaccuracy. LED indicates Variable Speed mode.
5	MARK EVENT	Two momentary switches permit manual marking of an event. When a MARK EVENT button is depressed, that event marker pen will deflect to the right. **NOTE: The EVENT MARKER pens will remain deflected until the MARK EVENT button is released. Event Marker will override timer event marker.**

ITEM	CONTROL	DESCRIPTION
6	*PEN POSITION POTS	Permits pen positioning anywhere within the channel.
7	PULL BAR	Pull to gain access to chart paper supply roll.
8	INTERLOCK INDICATOR	Lamp lights when writing table is not completely closed or paper supply is exhausted.
9	PAPER SUPPLY INDICATOR	Gauge to indicate quantity of chart paper remaining.
10	EXTERNAL CONTROL	When depressed, the recorder speed will be determined by an externally supplied pulse train, provided the system is in local** (or no connection is made to J-102 pin 6). This control is disabled in remote**. (External pulses may still be used in remote**, as explained in paragraph 3.8).
11	PREAMPLIFIERS	Refer to applicable preamplifier manuals for operating instructions.
12	THERMAL ANNOTATION HEAD	When activated will ANNOTATE on left edge of paper all or selected parts of the following message in the order listed. See NOTE on page 2.4. 1. Time 2. Date 3. Chart Speed 4. User Message 5. Test Number

*VARIABLE SPEED CONTROL and PEN POSITION pots contain locking knobs.

**Either "local" or "remote" is selected by the switch labeled "local-remote" in the remote speed control box shown schematically in Figure 3-4. "Local" means control by the recorder front panel controls. "Remote" means external control via J-102 and a circuit such as the Figure 3-5 box. See paragraph 3.8 for remote operation.

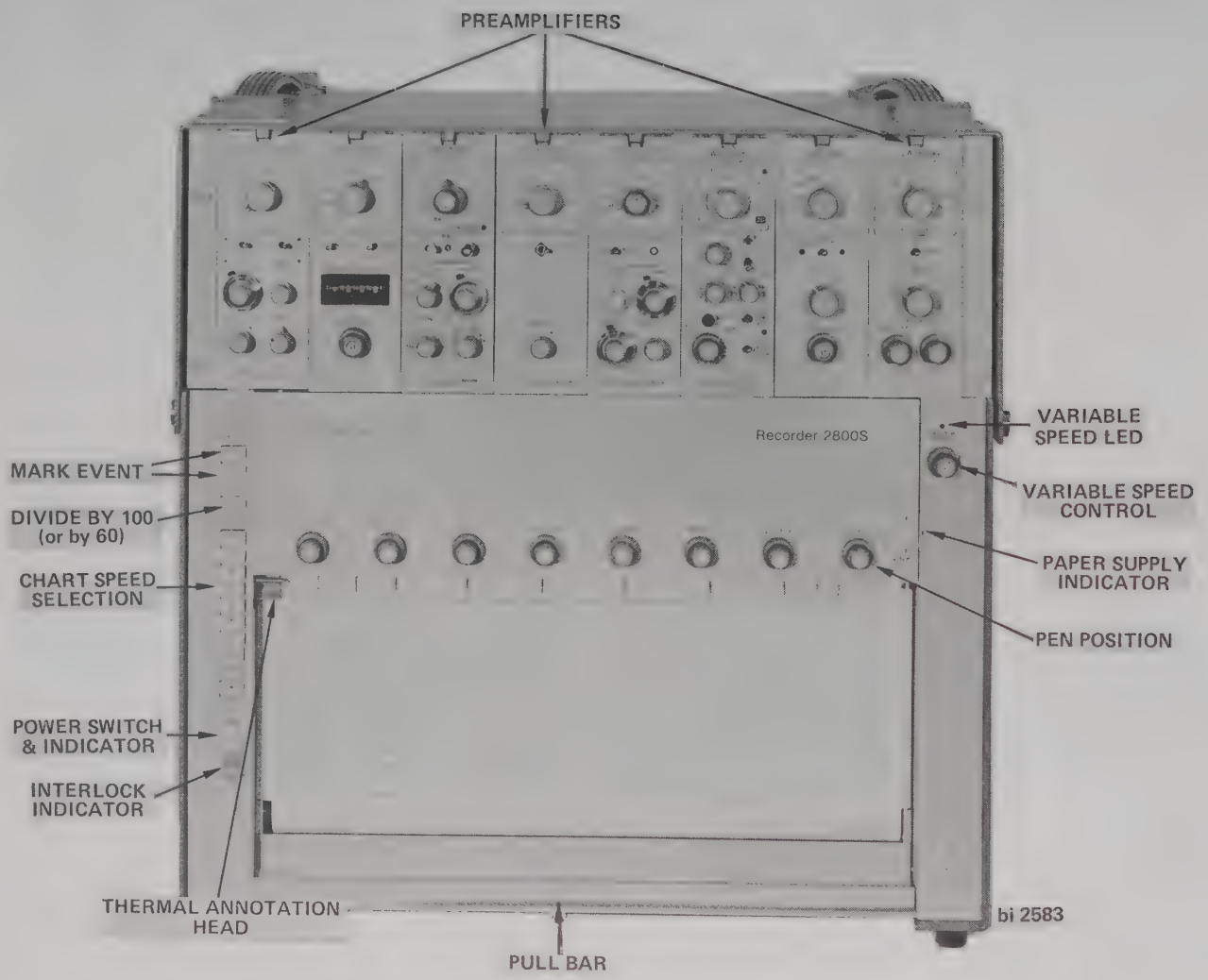


FIGURE 3-1 FRONT PANEL CONTROLS AND INDICATORS

3.3 REAR PANEL

Figure 3-2 illustrates the recorder rear panel. The list that follows corresponds to the items called out on Figure 3-2.

ITEM	CONTROL	DESCRIPTION
1	PREAMP CAGE	Houses preamplifiers if part of the recorder system.
2	SIGNAL INPUT	Jacks for signal input direct to drive amplifiers. (Overrides preamplifiers).
3	TERMINAL STRIP (TB-101)	Refer to paragraph 2.5 and 2.6 for description.
4	TIMER	ON/OFF toggle switch for timed left hand event marker activation. See Section 3.5.
5	MONITOR JACK	Monitors output of preamplifier (regardless of chart display). For use on Scope, Meter, Output panel, etc.
6	REMOTE CONTROL CONNECTOR (J-102)	Allows recorder to be operated from remote location. Proper input must be made to J-102 as explained in Section 3.8. IRIG-B (Thermal Annotation option) input, also available on this connector, allows time information from an external source, replacing the on-board real time clock. Information is pulse width coded and may be used as DC level shift coded (unmodulated digital TTL), BCD or binary format.
7	POWER INPUT CONNECTOR (J-101)	Connector accepts external power, i.e., 115/230V, 50-400 Hz.
8	RS232C CONNECTOR (J-103) See note 2.4	Serial User Input of various thermal annotation control and ASCII characters. The 300, 600, 1200, 2400, 9600, 14400, and 19200 BAUD are selectable by DIP switch on Processor Board. (Refer to Table 3-6 for pin-outs).
9	MANUAL DATA	Hex switches to enter two hexadecimal numbers for various thermal annotation control and ASCII characters, providing the user manual means of input instead of via RS232C.
10	SEND DATA	Pushbutton used to send hex switch information to microcomputer. The pushbutton has an error light to indicate that the message buffer is full, or that illegal data has been entered (use Table 3-2 and enter legal data).

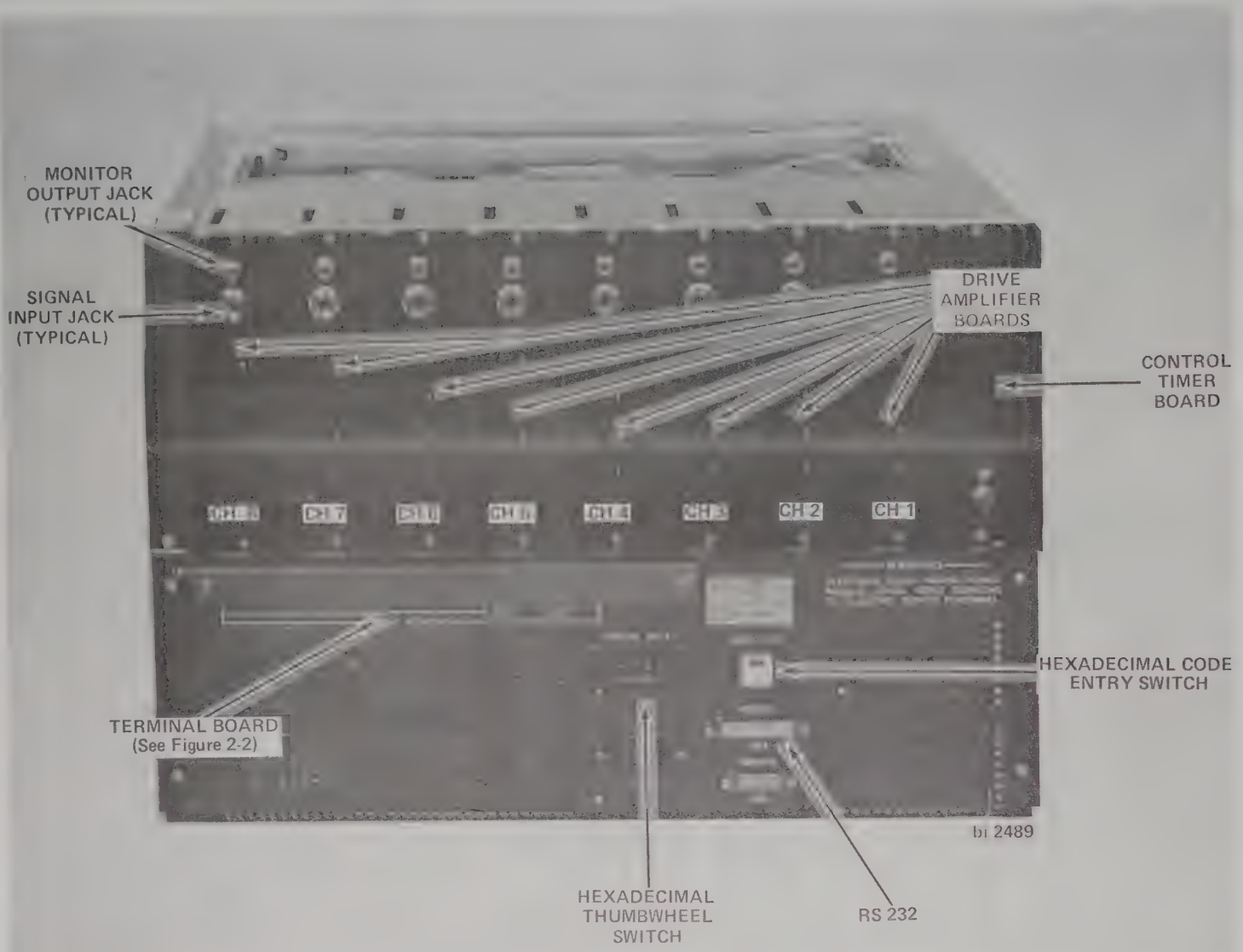


FIGURE 3-2 REAR PANEL
(2800 VERSION SHOWN)

3.4 INTERNAL CONTROL DIP SWITCH

Figure 3-3 illustrates DIP switch located internally on the Processor Board. Switches 2 and 3 program front panel speed selection switch for either divide by 100, 60 or 1000. Switches 4, 5 and 6 select RS232 Baud for optional thermal annotation kit.

NOTE: Divide by 1000 speed on ink writing model will result in excess ink bleeding.

3.5 TIMER SETTING

The timer actuates left event markers at a programmed repetition rate. Selection of repetition rates is made via switch S-702 on the Control Board. (See Figure 6-29.)

Set rate as follows:

NOTE: If the customer wishes the right event marker timer to be actuated, see paragraph 3.6.

1. Turn recorder power OFF.
2. Loosen the two screws which secure Control/ Timer board and pull board out of recorder. (See Figure 3-2).
3. Set switch positions for desired repetition rate per Table 3-1.
4. Replace control timer board and secure with screws.
5. Turn recorder power ON.
6. Turn TIMER switch ON. Timer ready for operation.

TABLE 3-1 SWITCH SETTINGS VS. TIMER REPETITION RATE

REPETITION RATE	SETTINGS	
	SW ON	SW OFF
0.1 SECOND	1, 3	2, 4, 5, 6, 7, 8
1.0 SECOND	1, 4	2, 3, 5, 6, 7, 8
10.0 SECONDS	1, 5	2, 3, 4, 6, 7, 8
100.0 SECONDS	1, 6	2, 3, 4, 5, 7, 8
0.1 MINUTE	2, 3	1, 4, 5, 6, 7, 8
0.10 MINUTE	2, 4	1, 3, 5, 6, 7, 8
1.00 MINUTE	2, 5	1, 3, 4, 6, 7, 8
10.00 MINUTES	2, 6	1, 3, 4, 5, 7, 8

3.6 RIGHT EVENT TIMER ACTUATION

By the removal of one resistor and the addition of another on the Control/Timer Board, the timer will actuate the right hand event marker.

Procedure for right event timing marks are as follows:

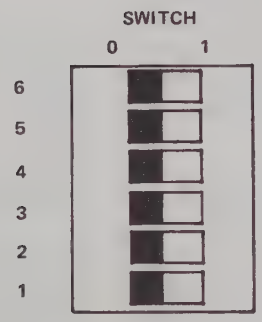
1. Turn recorder power OFF and disconnect AC power.
2. Remove the two screws which secure Control/ Timer board and pull board out of recorder.
3. Locate resistor R708 on the Control/Timer Board and remove it (see Figure 6-29).
4. Add resistor R709 to Control/Timer Board, 3.3 Kohm ±5% 1/4 watt carbon resistor part number 5-241111-332.
5. Replace Control/Timer Board and secure with screws.
6. Turn recorder power on.
7. Turn TIMER switch on. Right hand event marker should be responding to programmed repetition rate.

3.7 SET-UP AND OPERATION

Prepare recorder for operation as follows:

CAUTION: MAKE SURE ALL PROCEDURES DESCRIBED IN SECTION II, INSTALLATION HAVE BEEN PERFORMED.

1. Connect power source to recorder via power cable.
2. Check chart paper supply level. Make sure an adequate supply is present for length of time recorder is to be operated and that paper is properly threaded.
3. Check that chart STOP pushbutton is depressed (in).
4. Depress POWER pushbutton. POWER lamp will illuminate.



NOTE: ALL SWITCHES SHOWN IN O POSITION
(SWITCH LEVER SHOWN IN BLACK)

BAUD RATE SELECT

Switch 6 5 4	Frequency (Hz)	Baud Rate
0 0 0	2,400	300
0 0 1	4,800	600
0 1 0	9,600	1,200
0 1 1	19,200	2,400
1 0 0	76,800	9,600
1 0 1	115,200	14,400
1 1 0	153,600	19,200

DIVIDE-BY SELECT

Switch 3 2	Divisor
0 0	/100
0 1	/60
1 0	/1000*

NOTE: UNIT INOPERATIVE IF SWITCHES 3 & 2 ARE BOTH 1'S

*NOTE: The ÷ 1000 setting is not recommended for ink recorders. The very slow speeds may cause ink to "bleed" on the chart paper.

FIGURE 3-3 INTERNAL CONTROL DIP SWITCH

5. Set variable speed control full clockwise to detent.

6. Depress 5 mm/sec calibrated chart speed pushbutton (÷ 100 pushbutton should be out). Allow chart to travel about one foot. Press STOP button. Vertical traces from analog pen(s) down the center of the chart and vertical traces with timed marker (per paragraph 3.5) from the event marker pens on the chart edges will appear.

7. Depress 5 mm/sec chart speed pushbutton. Rotate pen position control(s) allowing analog pen travel to show full scale deflection within chart limits. Center pen(s) on chart with pen position control(s). Press STOP button.

8. Apply input signal(s) to recorder.

9. Depress calibrated chart speed pushbutton to that chart speed which best displays signal. Speed may be fractionally reduced as low as next slower calibrated speed by rotating variable speed control counterclockwise. Lock control in place when desired speed is attained.

10. When recorded data is completed, remove input signal(s), depress STOP button, and rotate variable speed control full clockwise unless setting is desired for recording future data.

11. Remove power by releasing POWER pushbutton.

3.8 REMOTE CONTROL OPERATION

The recorder may be operated remotely thru remote control connector J-102 located on the rear panel of the recorder. To attain this, mating connector P-102 (shipped loose with recorder) must be wired and closures provided per Tables 3-4 and 3-5. Figure 3-5 shows a suggested circuit for a remote control box (this box is not supplied by Gould as standard equipment with the recorder). Page 1 of Schematic Diagram 294232 located at the rear of this manual may be used as an aid. Signals S1 thru S4, STOP, ENABLE and x100 are pulled to a logic 1 internally. The stop signal pin number 1 of J-102 will override front panel speed selection if connected to a logic 0.

Chart speed is determined by signals S1-S4 per Table 3-5. As the table shows, these signals can also select speed control by an external pulse train by setting S2 to 1 (open) with S3 & S4 to 0 (closed). S1 doesn't matter for external pulse in.

Another feature in J-102 is a pulse output (pin 7), which can be used to synchronize the speed of other recorders (via their "EXT IN") to the speed of the main recorder. See Figure 3-4.

3.9 THERMAL ANNOTATION (11-2123-51)

Operation is standard for recorders originally equipped with Annotation or converted later with kit (11-2123-51). Control and data can be entered by either:

1. RS232C (J-103) connector (See Table 3-6).
2. MANUAL DATA and SEND DATA switches.

3.9.1 RS232 Information Input

User's terminal must be set to inhibit parity (disabled), full duplex, upper case enable, 8 data bits, 1 stop bit, 8th bit set to 0.

If the Lear Siegler ADM3A terminal is used, switches on the terminal should be set as illustrated in Figure 3-3A.

If the Pocket Terminal (Gould P/N 11-2403-14) is used, all switch settings inside of the terminal should be as illustrated in Figure 3-3B.

If the Televideo 910 terminal is used, switches on the terminal should be set as shown in Figure 3-3C.

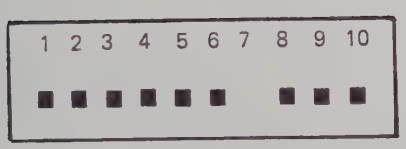
The following start-up procedure is representative of the ADM3A or the Televideo 910 terminal.

1. To enable data input (CR) return key must be entered first, and a prompt will appear (>) on the screen.

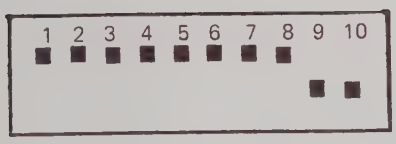
2. Enter CU then (CR) return key for STATUS LIST on screen.

3. If annotation is disabled, enter EA after > to enable annotation, then enter by pressing the (CR) return key.

4. Enable individual or all annotation by entering correct control character mnemonics from Table 3-2 after the prompt sign (>). Enter by pressing return key (CR).



S2



S1

FIGURE 3-3C

TELEVIDEO 910 SWITCH SETTINGS
FOR USE WITH 2000S SERIES RECORDERS WITH ANNOTATION

SHOWN - 9600 BAUD, 8 BIT WORD, PARITY INHIBIT, 1 STOP BIT, 8th BIT SET TO 0
(for other baud rates, see the TELEVIDEO 910 manual)

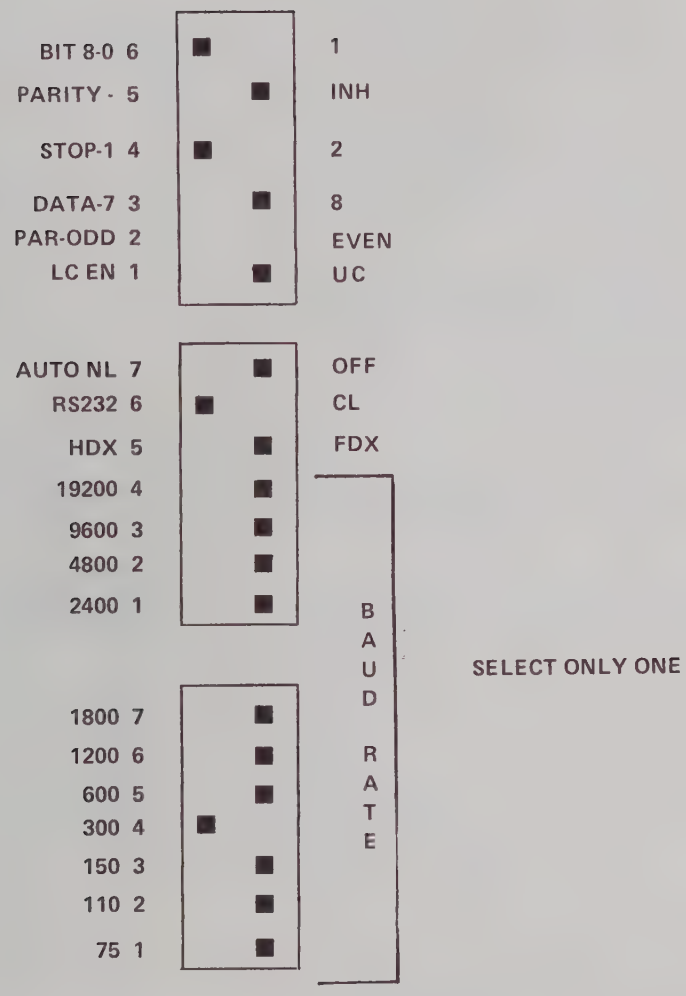
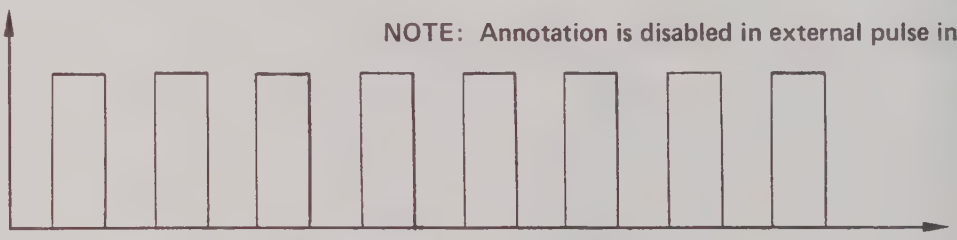


FIGURE 3-3A ADM3A SWITCH SETTINGS

FIGURE 3-3B POCKET TERMINAL, GOULD P/N 11-2403-14

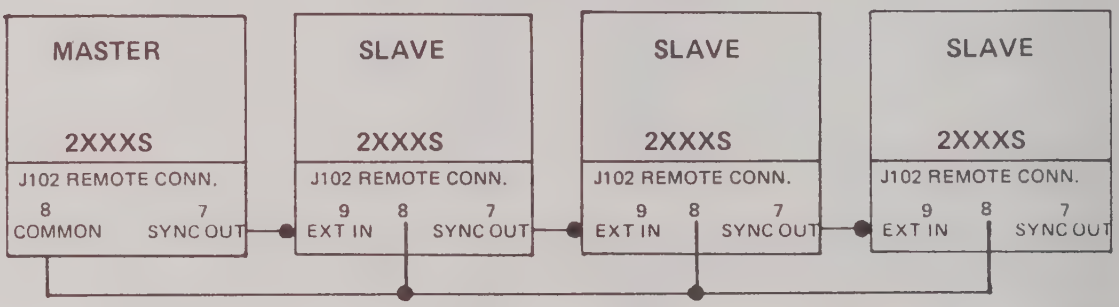
Ext. Pulse Input - 3 TTL loads, minimum of 10 μsec. positive pulse width from 0-20 KHz. Stepping occurs on negative transition of pulse. 79.8 pulses/mm.



NOTE: Annotation is disabled in external pulse input mode.

MASTER/SLAVE CONFIGURATION

2XXXS can synchronize up to 12 cascaded units. Each cable should be shielded, and should not exceed 20 feet in length.



NOTE: Only the master will annotate in the master/slave configuration.

FIGURE 3-4 EXTERNAL PULSE REQUIREMENTS

Example:

Individual Enable

>PT (CR) (Enable Time Printing)
>PD (CR) (Enable Date Printing)
>PS (CR) (Enable Speed Printing)
>PM (CR) (Enable Message Printing)

Total Enable

>TE (CR) (Enable Time, Date, Speed and Message Printing)

5. To set time or date, enter command followed by applicable data, eg:

   >STH 08 (CR) for 8 hours
   >STM 06 (CR) for month of June
   >STY 83 (CR) for the year 1983

6. To enter the message, enter EM command followed by no more than 50 characters (including spaces), and then (CR).

7. To set and enable test number printing, enter command (TN) followed by desired number. If number is not entered, default number 00 will be printed.

8. To increment test number, enter (CR) IN (CR).

9. European format will print Day-Month-Year instead of U.S. format Month-Day-Year, and will not update for daylight savings time.

10. To use IRIG-B, serial time code must be input on pin 12 of remote connector on rear panel. Code must be unmodulated data. (See IRIG B Operation 3.9.3)

11. Command DU enables a terminal to directly send data from the keyboard to be printed immediately on the chart. This feature does not work with the Pocket Terminal.

3.9.2 Hex Manual Data Information Input

If recorder is not printing, make sure annotation is enabled by entering Hex command code 90 (Enable Annotation) on MANUAL DATA switch and then push SEND DATA.

Check to see if any of the information is enabled on chart paper. If not, enable individual or all information by entering correct control character mnemonic Hex code from Table 3-2 and push SEND DATA switch to enter each.

Example

Individual Enable

Enable Time Printing - enter Hex 89 push SEND DATA

Enable Date Printing - enter Hex 88 push SEND DATA

Enable Speed Printing - enter Hex 8A push SEND DATA

Enable Message Printing - enter Hex 8B push SEND DATA

Total Enable - Enter Hex 92 push SEND DATA

Enable Time, Date, Speed and Message Printing - enter Hex 92 push SEND DATA

1. To set time or date, enter Hex code command and push SEND DATA, enter decimal value (not Hex value) on Hex switches and push SEND DATA.

TABLE 3-2 CONTROL CHARACTER MNEMONICS

Manual (Hex)	RS232	Description
00	NUL	Waveform time storage trigger
0D	CR	Carriage Return
80	STH	*Set Hours
81	STM	*Set Minutes
82	STS	*Set Seconds
83	SDM	*Set Months
84	SDD	*Set Day
85	SDY	*Set Year
86	EM	*Enter User Message
87	TN	*Set and Enable test number printing
88	PD	Enable date printing
89	PT	Enable time printing
8A	PS	Enable chart speed printing
8B	PM	Enable user message printing
8C	DD	Disable date printing
8D	DT	Disable time printing
8E	DS	Disable chart speed printing
8F	DM	Disable user message printing
90	EA	Enable annotation
91	DA	Disable annotation
92	TE	Enable date, time, speed and message
93	TD	Disable date, time, speed and message
96	US	Disable European format
97	IN	Increment test number
98	DN	Disable test number printing
99	IR	Enable IRIG input
9A	RT	Enable real time clock
9B	EX	Enable external trigger single print
9C	EU	Enable European format
9D	CU	Print data on user terminal
9E	DU	Enable direct data printing

*Must be folowed by legal data.

CAUTION: Do not use "DU" if Terminal does not have the 8th bit set to "0"

i.e., to set month:

Enter Hex 83 (set month command) then push SEND DATA

Enter Hex 06 (decimal value June) then push SEND DATA

Year:

Enter Hex 85 (set year command) then push SEND DATA

Enter Hex 83 (last 2 decimal digits of year) then push SEND DATA

2. To enter a user message enter Hex 86 (enter user message command code) then push SEND DATA. After this (numbers and letters) must be input in ASCII Code via Hex switches (see Table 3-3), one character at a time followed by pushing the SEND DATA button. If character is not a legal character, error light will come on until a legal character is entered. Error light will also come on if the message buffer is full. Entry of user message is terminated by a carriage return (0D) command, or by a chart speed change. Character entry mistakes can be erased by entering a RUBOUT character (7F) after the mistake is made.

3. User will be notified of any command or data input error by the error light on the push-button. It will be cleared by entering either proper data or a legal command.

4. To set and enable test number printing, a number must follow command input Hex 87 (set and enable test number), even if only 00. Test numbers are entered as straight decimal numbers via Hex switches.

5. Commands 80 through 87 must be followed by legal data or error light will come on.

6. Whenever a "00" is entered by the push-button or the external trigger (pin 13 of the remote connector), the time the event occurred will be stored in memory and printed on the next annotation cycle. An asterisk, instead of the usual arrow will indicate the real time the event occurred, then followed by an arrow with real time followed by date, speed and user message (providing they are enabled).

7. Command 9B enables a single printing of all selected annotation upon receipt of an external trigger. Set 9B on the thumbwheel switches. The "external trigger" is the pulling low of pin 13 of J102, the rear panel REMOTE connector. This provides the same function as

TABLE 3-3 HEX CODE CHART (ASCII)
(Only used in User Message Mode)

Numbers & Symbols				Upper Case Characters			
ASCII Symbol	Manual Hex	ASCII Symbol	Manual Hex	ASCII Character	Manual Hex	ASCII Character	Manual Hex
SP (Space)	20	0	30	@	40	P	50
		1	31	A	41	Q	51
"	22	2	32	B	42	R	52
=	23	3	33	C	43	S	53
S	24	4	34	D	44	T	54
%	25	5	35	E	45	U	55
&	26	6	36	F	46	V	56
'	27	7	37	G	47	W	57
(	28	8	38	H	48	X	58
)	29	9	39	I	49	Y	59
*	2A	:	3A	J	4A	Z	5A
+	2B	;	3B	K	4B	[	5B
,	2C	<	3C	L	4C	\	5C
-	2D	=	3D	M	4D	]	5D
.	2E	>	3E	N	4E	^	5E
/	2F	?	3F	O	4F	_	5F
<CR>	OD					Rubout (Delete)	7F

the SEND DATA button. Upon the first trigger, one printing will occur and annotation will cease. Thereafter each trigger will cause one printing. A carriage return will disable this condition.

3.9.3 IRIG-B Operation

To allow use of IRIG-B time code information from an external source, "Enable IRIG Input" must be entered as a command. Pin 12 on the rear panel remote connector is used to enter the data.

IRIG-B time code must be in BCD format, digital TTL unmodulated.

3.9.4 External Trigger (Waveform Time Storage)

The external trigger feature (on pin 13), described in 3.9.2 no. 6, may also be used with a Gould Multi-Channel Waveform recorder to store the exact time a trigger to the waveform recorder occurs. Then, when the chart is started by the waveform recorder, the stored time will be printed identified by an asterisk (*), followed by the real time as usual (marked by the arrow).

To use this feature, see 00 on the thumbwheel switches. Also, Model Number 896642 Chart Speed Control Cable Assembly must be used to connect the chart recorder REMOTE with the waveform recorder.

3.10 MASTER/SLAVE OPERATION

The 2000S Series Recorders also have the ability to slave several additional recorders to a Master Recorder. This operation allows the user to run several recorders at the same chart speed as the Master Recorder, up to 100 mm/sec chart speed. This is because at 200 mm/sec chart speed the software in the Master uses a double pulse frequency waveform to achieve 200 mm/sec chart speed and the Slaves never see the double pulse. All Slave Recorders must have the EXTERNAL pushbutton depressed to accept signals from the Master. Also, when the STOP button is depressed on the Master, the paper on the Master and Slaves stops as would be expected, and event pens and analog pens are inhibited. The Slaves can be manually operated at any time. For Master/Slave wiring and hook-up refer to Figure 3-4.

TABLE 3-4 SIGNAL INPUTS FOR REMOTE OPERATION

PIN NO.	SIGNAL NAME	DESCRIPTION Note: Control inputs are tied to logic 1 (5V) internally)
1	STOP	0 = Stop, 1 = Go. Same function as remote start/stop link on TB-101, terminals 3 & 4.
2	S3	See Table 3-5 for Remote
3	S2	Speed Select Bits speed
4	S1	Assignments
5	S4	
6	ENABLE	0 = Remote (pin 6 tied to pin 8). Enables remote speed select bits, pins 2 thru 5. 0 = TTL voltage of ground or 0V. 1 = TTL voltage of 5V (or switch open) gives local control (recorder front panel controls).
7	REMOTE SYNC	Output pulse with each motor step. Used to slave another recorder to Master.
8	COMMON	Logic 0
9	EXT	External pulse for step per pulse operation. (See Fig. 3-4).
10	X100	Defeats - 100 button on front panel. Active only in local mode.
12	IRIG-B	Used with standard Annotation unmodulated digital TTL BCD format time code input.
13	EX TRIG	Used with standard Annotation, when pulled low stores and prints real time the event occurred. Remains in memory and continues to print until another event occurs.

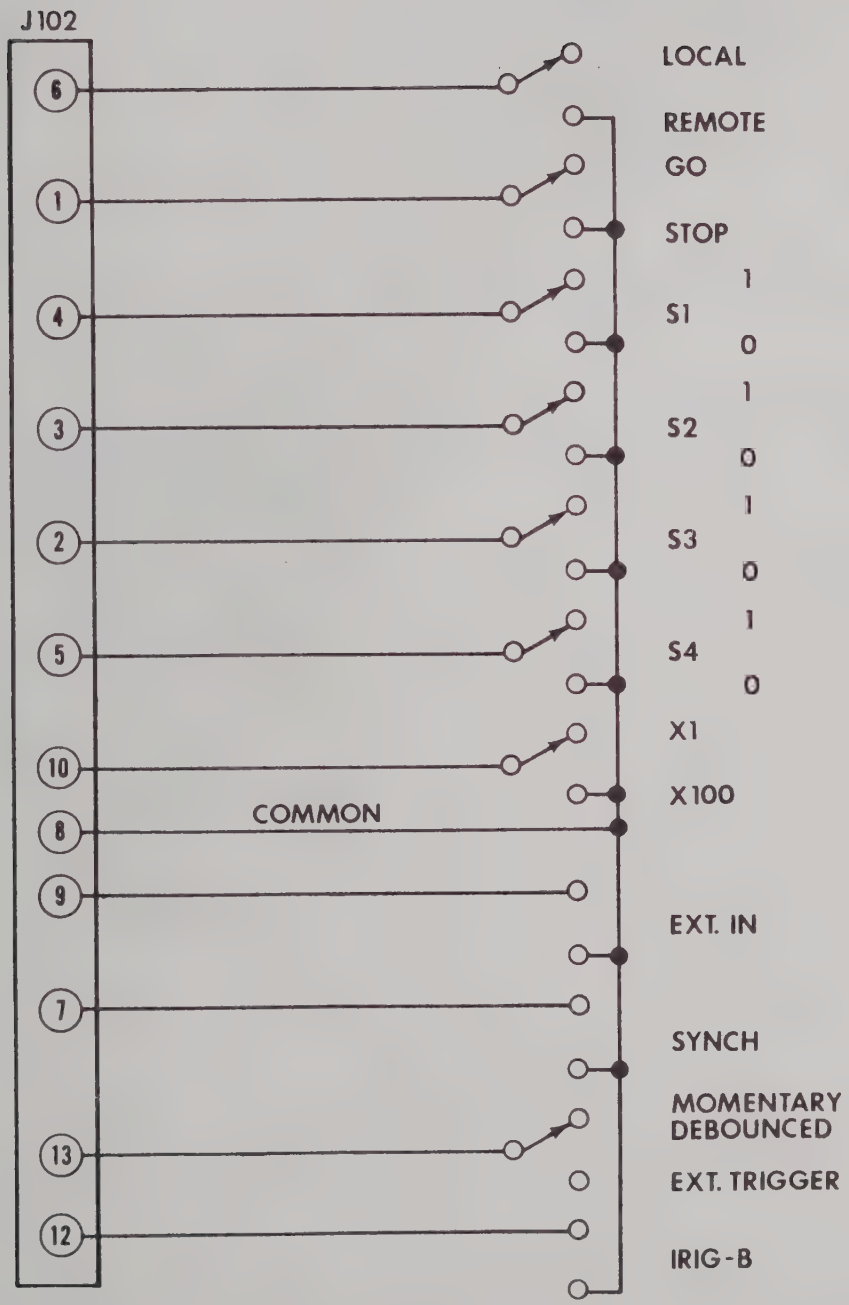
TABLE 3-5 REMOTE CONTROL PIN SPEED ASSIGNMENTS

SIGNAL NAME				SPEED
S1	S2	S3	S4	
0	0	0	0	200mm/sec
0	0	0	1	100mm/sec
0	0	1	0	50mm/sec
0	0	1	1	25mm/sec
0	1	0	0	External Pulse
0	1	0	1	10mm/sec
0	1	1	0	5mm/sec
0	1	1	1	STOP - Stops all speeds
1	0	0	0	2mm/sec
1	0	0	1	1mm/sec
1	0	1	0	.5mm/sec
1	0	1	1	.25mm/sec
1	1	0	0	External Pulse
1	1	0	1	.1mm/sec
1	1	1	0	.05mm/sec
1	1	1	1	STOP

NOTE: Remote Control Operation, overrides all Front Panel Controls except for the power ON/OFF pushbutton.

TABLE 3-6 RS232C CONNECTOR PIN NUMBERS J103

PIN NO.	SIGNAL NAME	DESCRIPTION
2	RXD	Serial data signal from user to recorder.
3	TXD	Serial data signal from recorder to user.
7	COMM	Signal Common.
21	+5V	Supply Voltage



REMOTE CONTROL BOX (NOT SUPPLIED BY GOULD)
FIGURE 3-5

SECTION IV

THEORY OF OPERATION

4.1 GENERAL

The 2000S Series Recorder is a modular constructed mainframe. Except for the number of channels and method of recording channel traces (ink or thermal) all models have common circuit boards.

Preamplifiers are optional and are discussed in their respective instruction manuals.

4.1.1 Mainframe (System Description)

The mainframe contains the following circuit boards discussed in the following theory of operation.

a. **Drive Amp Board (886220)** - receives an input signal from either signal input jack on rear or recorder or preamplifiers in plug-in slots to drive and control penmotors for each analog recording channel. Each channel is electrically identical.

b. **Processor Board (896073)** - contains a processing system for microstepping and annotation, along with the majority of the control electronics.

   The microstepping chart drive is implemented with an MPS 6502 microprocessor and the annotation control is implemented with an MC 6803 microcomputer. The electronics reside on seven printed circuit boards.

c. **Switch Amplifier Board (893618)** - contains the pulse width modulated power amplifier which drives the stepper motor.

d. **Control/Timer Board (894131 Ink, -1 Thermal)** - contains event marker circuits, fuses and event marker timer.

e. **Power Supply Board (896449)** - contains system power supply voltage, battery charger, low battery voltage cutoff and thermal print head protection.

f. **Encoder Board (894133)** - optical sensor to verify chart motion.

g. **Speed Select Board (893620-1 Ink, -2 Thermal)** - contains speed switches, remote interface and on thermal recorders, pen heat control.

h. **Variable Speed Control (893621)** - contains the potentiometer/switch for adjusting variable speeds.

The 2000S series recorder and annotation feature (standard on 2800S and 2600S Recorders, optional on all others) was made possible by LSI chip technology. This allows controls necessary for microstepping and annotation to be placed together within the limited physical space available. Two independent microcomputer systems, one for microstepping and the other for annotation, share common information in order to work together in the control of the recorder.

Although the software for both the microstepping and annotation reside on the processor board, they will be treated as separate functional blocks later in this theory of operation.

System functions (refer to Figure 4-1 Block Diagram System) are determined by the processor systems (1) and (2). Power for the systems is supplied by the Power Supply (12) and the systems clocks are supplied by the master clock (15).

The chart speeds are selected by the Speed Select Board (3) or the remote interface (4) if enabled, or an external TTL input (13) if enabled. The Speed Selector Board outputs a 4 bit code which is read by both processor systems. The microstepping processor after reading the speed selector code then monitors the step clock (9) to determine when a step should be taken. When it is time for a step, the microstepping processor system updates the output to the Switching Amplifier (5) which drives the stepper motor (8). The annotation processor system after reading the speed selector board code sends the speed information to the thermal print head (10) which prints the information on the left chart edge. If variable speed (11) is enabled the step clock system (9) frequency is reduced by up to 2.5 times and both processor systems (1) and (2) monitor the step clock (9) to determine when a step should be taken or when to print information, respectively. If the speed selected was 200mm/sec., the microstepping processor system will also monitor the Motion Detector (7) to insure the chart is actually moving and restart it if it has stopped.

To prevent the processor systems from not operating or operating erroneously a watchdog timer (14) monitors the microstepping processor system (1). If this processor system fails both processor systems (1) and (2) are reset to start again.

The microstepping processor system (1) also outputs a 10 Hz signal to the event marker timer (6) which is derived from the master clock (15) of 4 MHz.

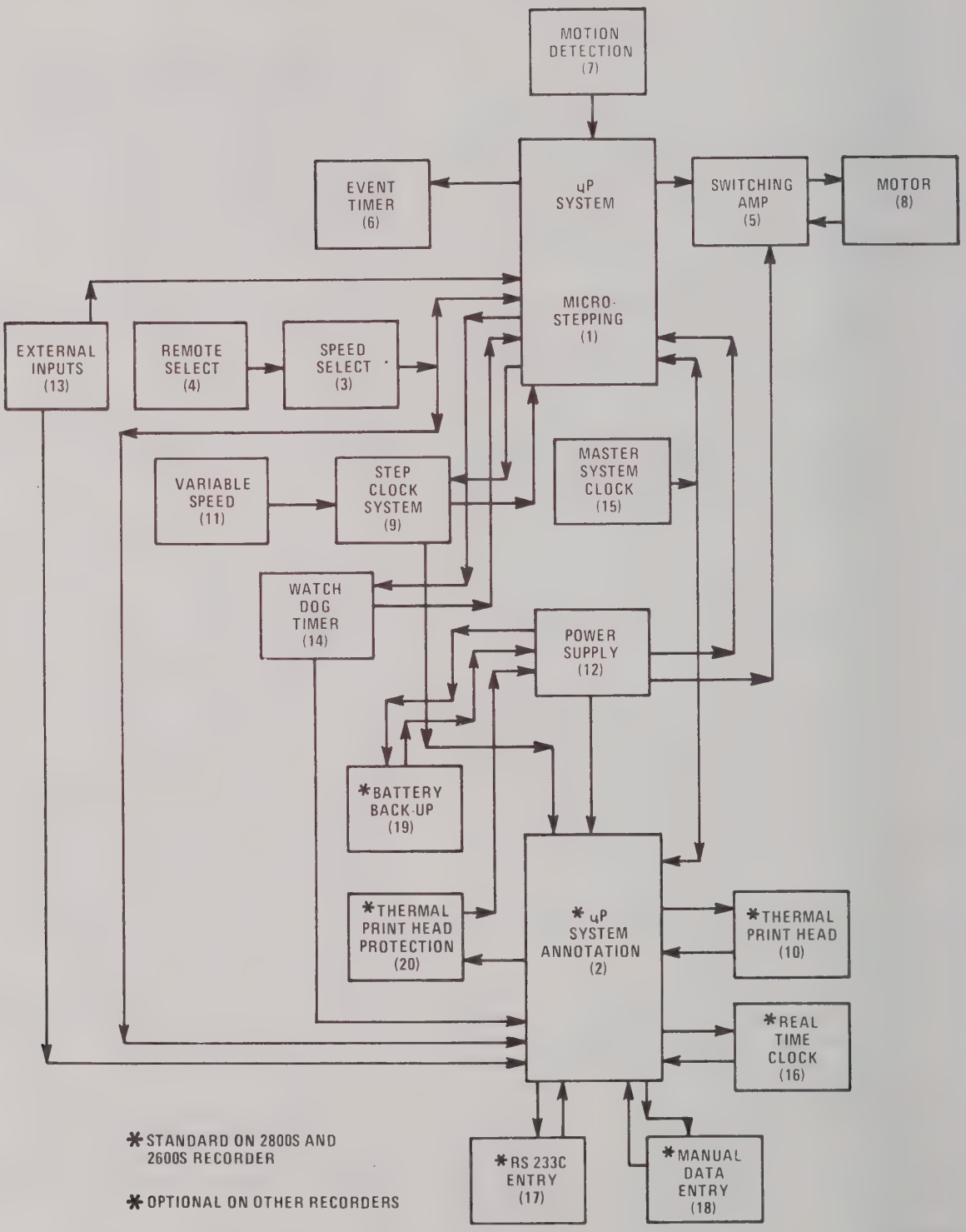


FIGURE 4-1 BLOCK DIAGRAM (OVERALL SYSTEM)

The annotation processor system (2) in addition to printing the speed information can also print time, date, user message, and a test number. The time and date information can be set for continued operation in the real time clock (16) by the RS232 input (17) or the manual data input (18) through the annotation processor system (2). In addition, the user message and test number can also be entered through these inputs (17) and (18) to the annotation processor system. An alternate time source (IRIG-B) can be entered through the external input (13) for printing to replace the real time printing if enabled. In the event of an AC power shutdown in the recorder, user message and test number information is retained in the memory of the annotation processor system (2), and the time and date will remain accurate for 72 hours in the real time clock (16) through the battery back-up (19). To prevent damage to the thermal print head (10) the thermal print head protection (20) monitors the on-time of the print head and turns the power to the print head off if the print head on-time exceeds 800 μsec.

4.1.2 Analog Recording Channels

a. General

Each Analog Recording Channel consists of a power transformer, pen drive amplifier, and penmotor. The 2000S Speed Select Board, 893620-1 (893620-2, Thermal), has additional circuitry for pen heat power. The channels are isolated from one another by using separate transformer power supplies and optical couplers. The optical coupler disables the pen drive amplifier whenever relay K-701 on the Control Board is de-energized from depressing chart STOP pushbutton or upon loss of AC power.

Each power transformer has two primary and three secondary windings. The primary windings can be wired in parallel for 115 VAC operation or in series for 230 VAC operation. Two of the secondary windings (±35 and ±15 volts) provide power to the pen drive amplifier. The third (13 VAC - may be used in preamplifiers requiring isolated power supplies for bridge excitation or suppression.

Figure 4-2 shows a block diagram of an analog channel. The penmotor drive amplifier is a complete servo system and uses a linear voltage displacement transformer (Metrisite*) in the penmotor to determine position, and velocity transducer for velocity. These signals are summed with the input signal in a DC error amplifier which, after amplification, drives the penmotor.

b. Signal Limiter

The input signal enters the Signal Limiter and is summed with the pen zero signal. The summed signal is fed to a diode bridge circuit. Output from the bridge is limited to ±2.6 volts.

c. Frequency Compensation Network

Output from the signal limiter is fed to a Frequency Compensation Network. Here, the signal's frequency response is adjusted to be flat within 2% from DC to 65 Hz for full-scale division pen deflection and from DC to 125 Hz for 10 division pen deflection. The frequency compensated signal is then fed to summing network where it is combined with error and velocity signals.

d. Oscillator and Demodulator

Position feedback is obtained from the Metrisite. Excitation for the Metrisite is obtained from a 20 KHz Wein Bridge Oscillator. A demodulator attenuates the 20 KHz carrier. Output from the demodulator is the position feedback signals.

e. Servo Control Amplifier

The compensated input signal, position feedback, and velocity are summed at the input of the Servo Amplifier. The output of this stage drives a Class B amplifier, which drives the pen to the proper position on the chart. This occurs when the summed signal is reduced to zero.

4.1.3 Chart Drive Control (Microstepping)

The 2000S Series Chart Drive Recorder is implemented using a stepper motor as the motion producer. The stepper motor is run in the microstepping mode rather than in the classical full or half stepping mode.

Microstepping is a method of achieving much smaller steps electrically. No gear trains are needed. The concept of microstepping is not new; however, the advent of microprocessors, inexpensive memory, and sophisticated analog integrated circuits have only recently made it a practical and viable alternative.

Classical full stepping of a four-phase stepper motor is accomplished by driving the four phases with four switches each 90° apart electrically. This is demonstrated graphically in Figure 4-3.

*Registered Trademark of Gould Inc.

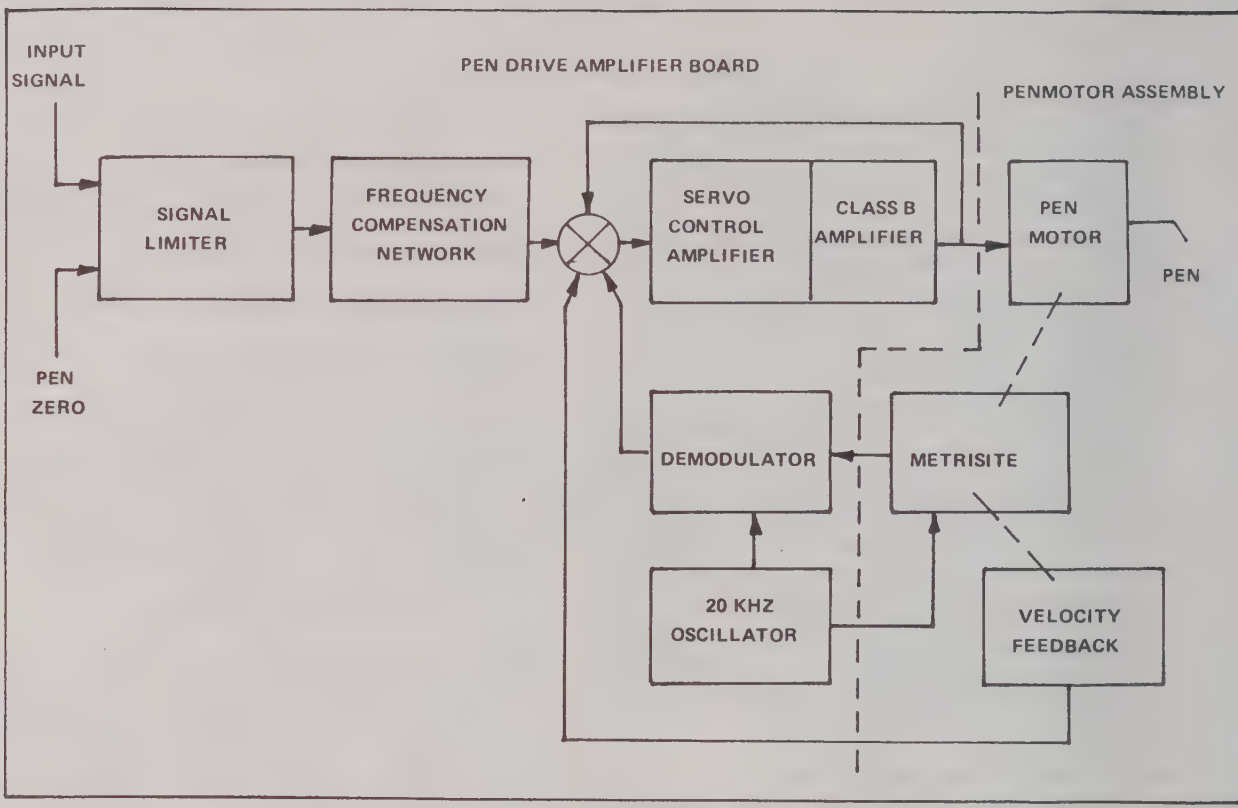


FIGURE 4-2 ANALOG CHANNEL BLOCK DIAGRAM

The vertical axis represents motor current in each of the four windings, and the horizontal axis represents time. A step occurs at each transition of any coil. The current waveforms are four symmetrical, unipolar square waves in a full quadrature relationship to one another. For a standard 1.8° motor of the type used in the 2000, each step represents 1.8° of angular motion, giving 200 steps per motor revolution.

To achieve microstepping, each of the current waveforms is changed to half-wave rectified sines maintaining the quadrature relationship as shown in Figure 4-4.

If the sine waves are truly continuous, no stepping occurs at all. The motor moves like a 200-pole synchronous motor. Achieving continuous sine waves which maintain an exact quadrature relationship independent of frequency is not practical. However, it is practical to generate sine waves digitally using a digital-to-analog converter and ROM based look-up table. This will divide the sine waves into small discrete steps. The motor will then step, but the steps will be much smaller than normal full steps. In fact, the microsteps will be equal to one full step divided by the number of increments in each quarter cycle of the sine wave, and they will be of equal size.

The 2000S uses this technique. Each quarter cycle is divided into 16 increments, giving 16 equal microsteps per normal full-step, or 200 x 16 = 3200 microsteps per revolution. Each microstep then will give a rotation of approximately .11° instead of the normal 1.8°. The waveforms of motor current will be as in Figure 4-5.

4.1.4 Annotation Control (Standard on 2800S and 2600S Recorders, optional on all others)

The 2000S series annotation is implemented using a thin film thermal print head. The print head is a 1 x 7 array which prints characters in a 5 x 7 format along the left chart edge. The annotation is capable of printing: Time in real-time or IRIG-B time code formats, Date in U.S. or European formats, chart speeds of fixed or variable speeds, user messages of up to 50 characters and a test number from 0 to 99.

For all chart speeds except 200mm/sec, power to the print head to create one row of dots of the 5 x 7 character format is achieved through two pulses of 500 μsec duration on-time and 1500 μsec duration off-time applied to each of the seven print head drivers, as in Figure 4-6.

FIGURE 4-3 FULL STEPPING

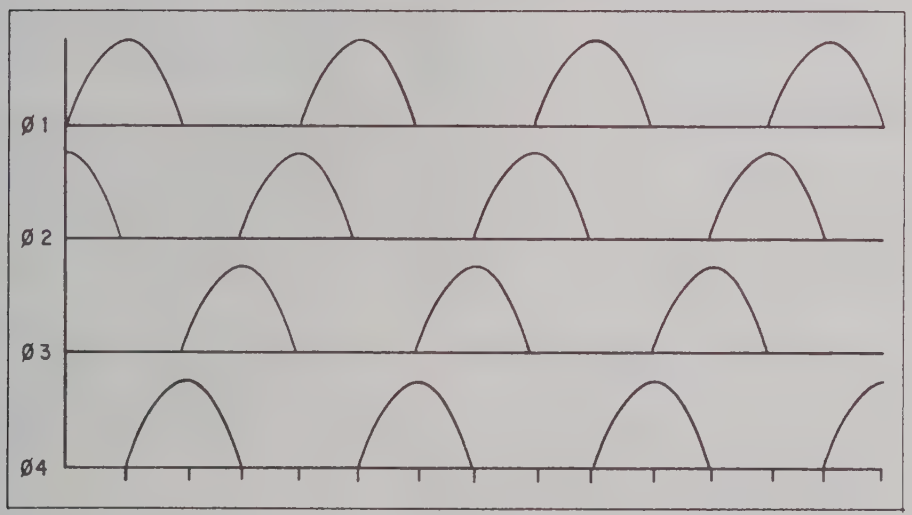


FIGURE 4-4 MICROSTEPPING

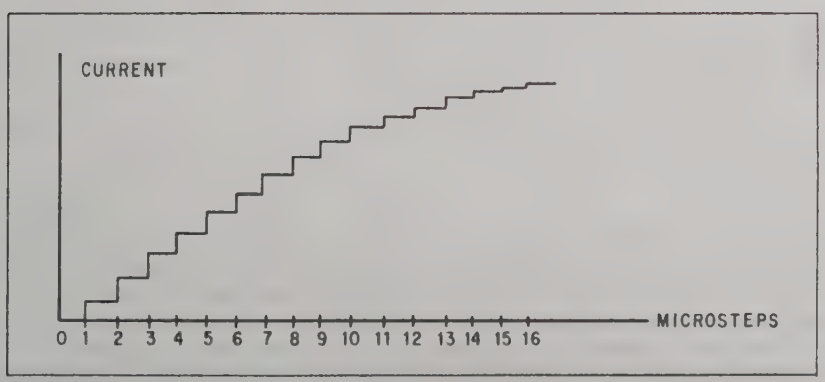


FIGURE 4-5 NORMALIZED PHASE CURRENT - 16 MICROSTEPS

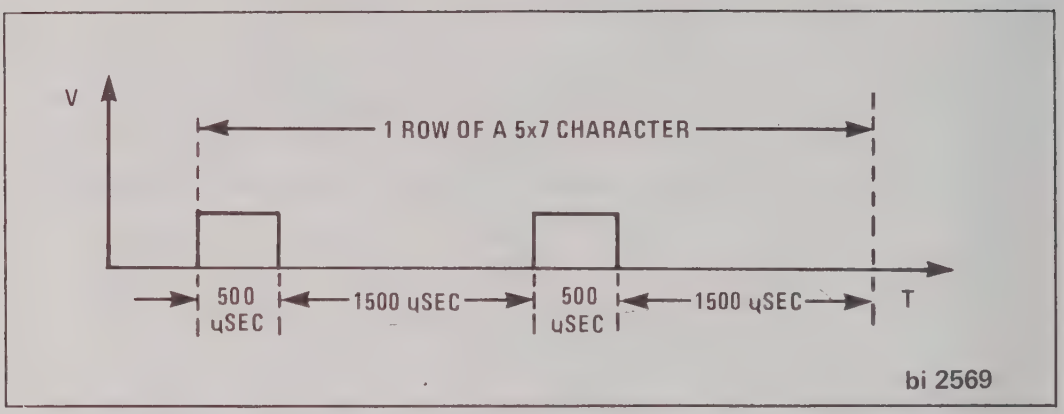


FIGURE 4-6 PRINT DUTY CYCLE FOR ALL SPEEDS EXCEPT 200MM/SEC.

At the 200 mm/sec chart speed, power to the print head to create one row of dots of the 5 x 7 character format is achieved through a single pulse of 600 μsec duration on-time and 1400 μsec duration off-time applied to each of the seven print head drivers, as in Figure 4-7.

The time required before the next row of dots is printed is a function of the chart speed selected. However, when power is applied to the print head for this next row and all subsequent rows, it will be applied as indicated previously above.

4.2 PROCESSOR BOARD (Refer to Schematic 296073 for the following Section 4.2)

The Processor Board is partitioned into two microcomputer systems. The microstepping system and the annotation system. Each microcomputer system will be broken down further into their functional blocks and discussed independently.

All addresses referred to are assumed to be hexadecimal for purpose of this discussion. Hexadecimal numbers will be preceded with $.

4.2.1 Microstepping Processor System (U6, U13, U14, U5)

The Microstepping Processor System consists of the microprocessor chip itself (U6), the scratch pad RAM (U13), the EPROM (U14) and address decoding sections of the semi-custom gate array chip (U5). The semi-custom gate array (U5) decodes addresses for the RAM, EPROM and I/O ports. Enable pins internal to the gate array ar driven by the Phase 2 clock. In this way all addres strobes are properly synchronized for Read/Writ operation without further gating.

The RAM (U13) is divided into two independen halves. Addresses $0000 thru $003F are scratc pad locations and used by the program. Locatio $0140 thru $017F are the system stack. The tw are separated by ignoring address bits A6 and A7 and using address bit A8 instead.

The EPROM (U14) is decoded at address $700 thru $77FF. Since address bit A15 is ignored addresses $F000 thru $FFFF will also select th EPROM, allowing the processor to fetch its vecto for Reset and IRQ (see 6502 processor manual fo details).

Address decoding is performed by semi-custo gate array U5. Many of the decoded addresses ar used internally in the gate array and do not appea to the outside circuitry. The exact addresses an their function are listed in Table 4-1.

4.2.1.1 Step Clock System (U24, U25, U32, U27)

The Step Clock is used to synchronize the char speeds. The clock runs at the maximum steppin frequency (approximately 16 KHz). All speeds ar generated by counting step clocks.

The Step Clock System consists of U24, U25, U32 half of U27 and associated discrete components

TABLE 4-1 SEMI CUSTOM GATE ARRAY (U5) ADDRESS DECODING

ADDRESS	U5 PIN NO.	FUNCTION
$0000	9	RAM Locations.
$1000R	internal to U5	D6 external pulse, D7 Step Clock.
$1000W	38	D0-D6 Sine Data to motor D7 Sine Gate to motor.
$1001R	internal to U5	D7 - 2 time Step Clock.
$1001W	39	D0-D6 Cosine Data to motor D7. Cosine gate to motor.
$1002W	internal to U5	D0-D3 outputs speed select code (see 4.2.1.3).
$1003R	internal to U5	D0-D7 counts Step Clock period to low byte (see 4.2.1.2).
$1003W	40	D0-D7 output to Step Clock DAC (U25).
$2000	internal to U5	D0-D1 Hi byte of Step Clock period counter (see 4.2.1.2).
$3000	32	D0-D7 frequency reference input switch.
$3001	U1 pin 3	D0-D2 divide-by switches.
$4000	internal U5	D7 - uncalibrated switch.
$5000	20	Strobe used to accelerate Step Clock.
$7000	10	EPROM

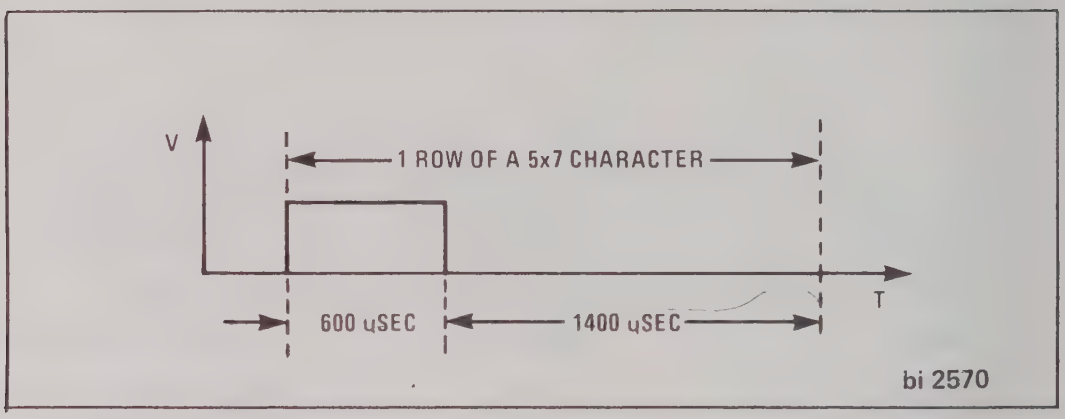


FIGURE 4-7 PRINT DUTY CYCLE FOR 200MM/SEC CHART SPEED

The clock is generated by U24, (LM331) voltage to frequency converter. Pin 7 of U24 is the input voltage control signal. U32 pin 6 is the summing point which builds this voltage. The reference voltage comes thru R15 from the variable speed pot and the 5V power supply. In addition, the processor is able to adjust this voltage, and therefore, the clock frequency by writing data to U25, a DAC. This adjusting voltage appears at TP-1 and is scaled by R12, R13 and R14 so a one LSB change on U25 gives no more than one LSB change in frequency. The mechanics of this exchange will be explained in greater detail in the microstepping software section.

4.2.1.2 Step Clock Period Counter

This is actually part of the Step Clock System and is internal to U5, the semi-custom gate array. The Step Clock period counter allows the processor to measure the Step Clock period using the 4 MHz crystal as a reference. Then, if the period is incorrect due to time or temperature drift, the processor can adjust it using U25, DAC.

At each transition of the Step Clock Phase 2 signal, the processor U6 determines whether or not to take a step. If it decides not to step, it then reads the Step Clock period by the internal address in U5 of $1003R and $2000. If the Step Clock period is low indicating the frequency is too high, the processor decrements U25 to bring it back down. If the period is high, U25 is incremented to bring the frequency up.

The correct period is determined by the processo and the Step Clock calibration reference switc (U20 and SW1). When any of the front pan switches are pressed, the processor reads SW1 an adds its value to Hex $1070 to build a referenc period. This gives a range of $0170 to $026F for period range from 46 to 77.8 μsec. The nomina period (switch setting $86) is 62.7 μsec. In th manner, the chart speeds can be trimmed t compensate for mechanical errors.

4.2.1.3 Speed Selector

The Speed Selector consists of U5, which reads a front panel switches, codes K101, K102, K10 K104, plus U26 and SW2 for various divide-b speed capabilities. The chart speed select cod come from the switchboard and appear on U5 pi 13, 14, 22 and 24 (see Table 4-2 for codes). K10 U5 pin 13, determines if the divide-by chart spee is enabled. If it is enabled, SW2 and U26 allow th processor to distinguish which divide-by selected: divide by 60, divide by 100 or divide b 1000.

If a new speed switch is depressed, the code on th switches becomes different from that on th output port internal to U5 causing the new spee output U5 pin 21 to go low. This pin is connecte to the reset line of the microprocessor U6 pin 4 via U7 and U3. A low on the reset line wi interrupt the microstepping processor and the rese returning high will force the processor to begi executing the beginning of the program, searchin for the proper chart speed code to send the ne speed line high. The program has approximately

TABLE 4-2 SPEED CODES

CODES FROM SPEED SELECTOR BOARD				SPEEDS (DIVIDE BY SPEED SELECTABLE BY SW2)		
K101 (D3)	K102 (D2)	K103 (D1)	K104 (D0)	Divide by 100 (D0)(D1) 0 0	Divide by 60 (D0)(D1) 1 0	Divide by 1000 (D0)(D1) 0 1
0	0	0	0	STOP	STOP	STOP
0	0	0	1	.05mm/sec	5mm/min	.005mm/sec
0	0	1	0	.1mm/sec	1mm/min	.01mm/sec
0	0	1	1	EXT	EXT	EXT
0	1	0	0	.25mm/sec	25mm/min	.025mm/sec
0	1	1	0	.5mm/sec	50mm/min	.05mm/sec
0	1	1	0	1mm/sec	100mm/min	.1mm/sec
0	1	1	1	2mm/sec	200mm/min	.2mm/sec
D3-1 DIVIDE BY SPEED INACTIVE						
1	0	0	0	STOP	STOP	STOP
1	0	0	1	5mm/sec	5mm/sec	5mm/sec
1	0	1	0	10mm/sec	10mm/sec	10mm/sec
1	0	1	1	EXT	EXT	EXT
1	1	0	0	25mm/sec	25mm/sec	25mm/sec
1	1	0	1	50mm/sec	50mm/sec	50mm/sec
1	1	1	0	100mm/sec	100mm/sec	100mm/sec
1	1	1	1	200mm/sec	200mm/sec	200mm/sec

Step Clock period to find the correct speed code before resetting to try again. When the correct speed code is found, the new speed line goes high and the processor can now execute this chart speed.

4.2.1.4 Motor Drive Outputs (U27, U28, U33, U34)

The Motor Drive outputs come from U27, U28, U33 and U34. U28 and U33 are DACs which the Processor uses to generate the SIN and COS signals for the switching amplifier. The code is 7 bit binary, bit 0 (LSB) pin 11 of the DACs is grounded (logic 0). The eighth bit is latched by the two halves of U34 to provide the SIN GATE and COS gate. The SIN and COS signals are full wave rectified. The two gate signals direct the SIN and COS to the proper motor coil. All four signals come from the look-up table in the EPROM, U14.

4.2.1.5 Chart Motion Detection

This section consists of U5 pin 18 and U12. An optical detector is set up to give eight pulses per motor revolution. These pulses are synchronized to the Step Clock by U5. U12 is a retriggerable 1-shot with a time constant of approximately 150 msec. As long as the encoder pulses arrive at a sufficient rate to keep the timer triggered, the output on U12 pin 10 will be high. If the pulses stop arriving, the 1-shot times out and U12 pin 10 drops low causing an IRQ interrupt to the processor. This interrupt is masked by the software so that it is ignored by the processor for all speeds except 200mm/sec. At this speed the chart must be accelerated gradually and if the chart should stop for any reason, the IRQ informs the processor to re-accelerate. It does this by shorting C14, which then charges again exponentially causing the control voltage on VCO, U24, to do the same. The signal that shorts C14 also retriggers U12, allowing 150 msec for the chart to build up enough speed to keep IRQ high.

4.2.1.6 Watch Dog Timer

This circuit consists of U3, U7, U9 and U11 and is intended to provide a failsafe reset if the processor should operate erroneously or stop operating. Address $7000, the address for the EPROM, is monitored for operation, if no activity has been sensed on this address for approximately 125 μsec, the processor will begin execution of its program

at the beginning. Essentially this is the same as if the power to the recorder was re-turned on with all new initiation resulting.

4.2.2 Annotation Processor System (U31, U30, U39, U40, U19)

The Annotation Processor System consists of the microcomputer chip itself, U31; the EPROM U30, the octal latch U39, and the decoders U19 and U40.

The microcomputer chip is the MC6803 and is operated in the expanded-multiplexed mode, Mode 2 (see 6803 processor manual for details). The MC6803 internally consists of four parallel I/O ports, a serial communications interface, a 128 x 8 RAM, and a three function programmable timer. The microcomputer multiplexes the lower 8 address bits with the 8 data bits. In order to get a full 64K byte address bus, U39, the octal latch separates the address code from the data code using the address strobe U31 pin 39.

The RAM is internal to the MC6803 and is decoded internally from $0080 thru $00F0 (see 6803 processor manual). 64 bytes of this RAM $0080 thru $00BF are capable of being battery supported, for memory retention with AC power removed.

The EPROM (U30) is an 8K x 8 (2764) memory chip and is decoded starting at address location $7000. It is divided into two halves $7000 thru $7FFF and $F000 thru $FFFF by ignoring address A12 and using A15 instead. This allows the interrupt vectors to be fetched from the upper half of this memory $FFF0 thru $FFFF.

Address decoding is performed for the non-multiplexed bus by U19. These decoded addresses are gated with the system clock for synchronization. The exact addresses and their functions are listed as follows in Table 4-3.

Further decoding is performed by U40 which decodes address $1000 for the Real Time Clock U38. The decoding by U40 is required for the real-time clock, which operates off the multiplexed address/data bus, because this bus does not require synchronization with the system clock.

4.2.2.1 Chart Speed Printing

Speed selector codes are entered to the annotation processor system to inform it what chart speed the Microstepping Processor System is operating, so it can print this information on the chart edge. The annotation microcomputer (U31) reads the chart speed select codes through U5, U26, SW2 and U29. The chart speed select codes come from the switch board and appear on U29 pins 17, 16, 15, 14. Also the divide-by setting, selected by SW2 and U26 appear on U29 pins 12 and 13. Similarly, as described in 4.2.1.3, K101 U29 pin 17 determines if a divide-by chart speed is enabled. If the divide-by is enabled, SW2 and U26 allows the microcomputer to determine which divide-by is selected /60, /100 or /1000 (see Table 4-2 for codes).

The Annotation Processor (U31) will know when it can find the correct chart speed selector code, by the new speed line U5 pin 21. This line is connected

TABLE 4-3 ANNOTATION NON-MULTIPLEXED U19 BUS DECODING

ADDRESS	U19 PIN NO.	FUNCTION
$2000	11	D0-D7, PIA U29, chart speed inputs, divide-by setting and manual data input.
$3000	12	D0-D6 data to thermal print head
$4000	7	D6-D7 IRIG-B input code.
$5000	6	D7 error indicator LED on send data switch.
$6000	5	Strobe to reset IRIG.
$7000	4	EPROM location.

to the microcomputers NMI through U3 and U7. A low transition on the new speed line causes an interrupt to the microcomputer, telling it to get the new speed select code.

The microcomputer also monitors the step clock and variable speed switch. When the variable speed switch is moved to the uncalibrated position, the microcomputer senses this on U31 pin 20. The microcomputer then monitors the step clock on U31 pin 8 to determine at what chart speed the recorder is operating. A further explanation of this mechanism will be discussed in the annotation software section, under the variable speed heading.

4.2.2.2 User (RS232C or Manual) Inputs

Additional information besides the chart speed information for printing on the chart edge can be entered to the annotation processor system through an RS232C input or a manual data input.

a. RS232C Input

The RS232C input allows a user to enter information into the annotation processor system and also review the status of this information without printing the information on the chart edge (see Table 4-4 for codes). The RS232C input consists of U31, U15, U23, U10 and SW2. The MC6803 microcomputer (U31) internally contains a serial communication interface that is accessible through pins 12 and 11. Level translaters U15 for the transmit line J8 pin 4 and U23 for the receive line J8 pin 1, allow the microcomputer to interface to data communication equipment in conformance with the specifications of EIA Standard No. RS232C. Baud rates for this communication are selectable using SW2 and baud rate generator U10 (see Table 4-5 for baud rates). These baud rates enter the microcomputer to the serial communication interface through U31 pin 10.

b. Manual Data Input

The Manual Data Input allows a user to enter information into the annotation processor system. With this input, other equipment, such as an RS232C terminal is not required for entering information, permitting the recorder to stand alone in its operation. The Manual Data Input consists of U31, U29, U2 and two switches, the Manual Data Switch and the Send Data Switch (located on the rear recorder panel). The manual data input works as follows: first a code is entered, by a user, on the Manual Data Switch (see Table 4-4 for codes). This code then appears on the PIA U29 pins 2, 3, 4, 5, 6, 7, 8 and 9. The user next pushes the Send Data Switch which is connected to the PIA's interrupt input U29 pin 40. The PIA in turn pulls the IRQ line low which is connected to the Microcomputer U31 pin 5 causing an interrupt. The microcomputer upon receiving this interrupt can read the Manual Data Switch information through the PIA. If an erroneous code was entered, the microcomputer addresses $5000 which triggers U2 and turns on an LED in the Send Data Switch.

4.2.2.3 Time Information (Real Time Clock or IRIG-B)

Time Information for printing on the chart edge can be maintained for the annotation processor system by a real-time clock or an IRIG-B system time code.

a. Real-Time Clock

The Real-Time Clock (U38), an MC146818 is a peripheral device for the microcomputer that controls the time information in the annotation processor system. The real-time clock features include: a time of day clock with 100 year calendar, a square-wave generator and 50 bytes of RAM. The real-time clock is settable through the annotation processor system by the User Inputs. The microcomputer communicates with the real-time clock by address $1000 and the multiplexed address/data bus. The real-time clock has battery back-up on U38 pin 24 to retain its information if AC power to the recorder is removed. The real-time clock also generates through U38 pin 23 a square-wave of 1024 Hz which is used to gate the IRIG-B time code information (discussed next).

b. IRIG-B

The IRIG-B is a system time code that can replace the real-time clock as the time keeper for the annotation processor system. The IRIG-B system consists of U1, U21, U18, U17, U8 and U21. The IRIG-B system operates as follows. First, a non-modulated IRIG-B signal must be input on J5 pin 7. This signal is then buffered by U21. The IRIG-B signal is next gated with 1024 Hz from the real-time clock by U18. The IRIG-B time code contains position marks, logic 1's and logic 0's which when

TABLE 4-4 USER INPUT COMMANDS

Control characters in range of Hex 80-9F including OD,
CR to be used for RS232 or Hex Switch inputs

	RS232 FORMAT		HEX FORMAT	
Command Description	Keyboard Command Mnemonics	Entry Protocol	Hex Code Thumbwheel Command Mnemonics	Entry Protocol
Waveform Time Storage Trigger		N/A	00	Set 00; press Send Data SW.
Carriage Return	CR	N/A	0D	N/A (Used to terminate data entry)
Set Hours	STH	(CR) STH DD (CR)	80	Enter Hex 80; press Send Data SW. Enter decimal number DD; press Send Data SW.
Set Minutes	STM	(CR) STM DD (CR)	81	Enter Hex 81; press Send Data SW. Enter decimal number DD; press Send Data SW.
Set Seconds	STS	(CR) STD DD (CR)	82	Enter Hex 82; press Send Data SW. Enter decimal number DD; press Send Data SW.
Set Month	SDM	(CR) SDM DD (CR)	83	Enter Hex 83; press Send Data SW. Enter decimal number DD; press Send Data SW.
Set Day	SDD	(CR) SDD DD (CR)	84	Enter Hex 84; press Send Data SW. Enter decimal number DD; press Send Data SW.
Set Year	SDY	(CR) SDY DD (CR)	85	Enter Hex 85; press Send Data SW. Enter decimal number DD; press Send Data SW.
Enter User Message (Message stored in memory)	EM	(CR) EM CCC--C*(CR)	86	Enter Hex 86; press Send Data SW; enter XX; press Send Data SW., repeat entering XX and pressing Send Data SW until message is completely entered, then enter 0D to terminate user message entry. XX must be ASCII format (use Table 4-4A).

TABLE 4-4 USER INPUT COMMANDS (continued)

	RS232 FORMAT		HEX FORMAT	
Command Description	Keyboard Command Mnemonics	Entry Protocol	Hex Code Thumbwheel Command Mnemonics	Entry Protocol
Enable & Set Test Number Printing	TN	(CR) TN CC (CR)	87	Enter Hex 87; press Send Data SW; enter decimal number DD; press Send Data SW.
Enable Date Printing	PD	(CR) PD (CR)	88	Enter Hex 88; press Send Data SW.
Enable Time Printing	PT	(CR) PT (CR)	89	Enter Hex 89; press Send Data SW.
Enable Chart Speed Printing	PS	(CR) PS (CR)	8A	Enter Hex 8A; press Send Data SW.
Enable User Message Printing	PM	(CR) PM (CR)	8B	Enter Hex 8B; press Send Data SW.
Disable Date Printing	DD	(CR) DD (CR)	8C	Enter Hex 8C; press Send Data SW.
Disable Time Printing	DT	(CR) DT (CR)	8D	Enter Hex 8D; press Send Data SW.
Disable Chart Speed Printing	DS	(CR) DS (CR)	8E	Enter Hex 8E; press Send Data SW.
Disable User Message Printing	DM	(CR) DM (CR)	8F	Enter Hex 8F; press Send Data SW.
Enable Annotation	EA	(CR) EA (CR)	90	Enter Hex 90; press Send Data SW.
Disable Annotation	DA	(CR) DA (CR)	91	Enter Hex 91; press Send Data SW.
Enable Date, Time, Speed & Message Printing	TE	(CR) TE (CR)	92	Enter Hex 92; press Send Data SW.
Disable Date, Time, Speed & Message Printing	TD	(CR) TD (CR)	93	Enter Hex 93; press Send Data
Reset Real Time Clock	RC	(CR) RC (CR)	94	Enter Hex 94; press Send Data SW.
Disable European Format	US	(CR) US (CR)	96	Enter Hex 96; press Send Data SW.
Increment Test Number	IN	(CR) IN (CR)	97	Enter Hex 97; press Send Data SW.
Disable Test Number Printing	DN	(CR) DN (CR)	98	Enter Hex 98; press Send Data SW.
Enable IRIG Input	IR	(CR) IR (CR)	99	Enter Hex 99; press Send Data SW.

TABLE 4-4 USER INPUT COMMANDS (continued)

RS232 FORMAT			HEX FORMAT	
Command Description	Keyboard Command Mnemonics	Entry Protocol	Hex Code Thumbwheel Command Mnemonics	Entry Protocol
Enable Real Time Clock	RT	(CR) RT (CR)	9A	Enter Hex 9A; press Send Data SW.
Enable Ext. Trigger Single Print	EX	(CR) EX (CR)	9B	Enter Hex 9B; press Send Data SW.
Enable European Format	EU	(CR) EU (CR)	9C	Enter Hex 9C; press Send Data SW.
Print Data on User Terminal (Current Status)	CU	(CR) CU (CR)	9D	Enter Hex 9D; press Send Data SW.
Enable Direct Data Printing (Data is not stored)	DU	(CR) DU CCC--C (CR)		

C = Alpha Characters
D = Decimal Numbers
XX = Two hex digits to represent an ASCII character
(CR) = Carriage Return on pocket terminal or return key on ADM3A terminal.
*Up to 50 characters of alphanumeric data can be entered into the user message.

TABLE 4-4A HEX CODE CHART (ASCII)

Numbers & Symbols				Upper Case Characters			
ASCII Symbol	Manual Hex	ASCII Symbol	Manual Hex	ASCII Character	Manual Hex	ASCII Character	Manual Hex
SP (Space)	20	0	30	@	40	P	50
!	21	1	31	A	41	Q	51
"	22	2	32	B	42	R	52
#	23	3	33	C	43	S	53
$	24	4	34	D	44	T	54
%	25	5	35	E	45	U	55
&	26	6	36	F	46	V	56
'	27	7	37	G	47	W	57
(	28	8	38	H	48	X	58
)	29	9	39	I	49	Y	59
*	2A	:	3A	J	4A	Z	5A
+	2B	;	3B	K	4B	[	5B
,	2C	<	3C	L	4C	\	5C
-	2D	=	3D	M	4D	]	5D
.	2E	>	3E	N	4E	^	5E
/	2F	?	3F	O	4F	_	5F
<CR>	OD					Rubout (Delete)	7F

gated with U18 allows a series of approximately 8, 5 and 2 code pulses of 1024 Hz respectively to counter U2. At the beginning time frame of each IRIG-B signal, on a high transition, the counter is used by U8 and U1 to begin counting these pulses. If the number of pulses counted by U2 was an 8 (position mark) a 1 will be present on D7 and a 0 on D6 when U17 is addressed by $4000. For 5 pulses (logic 1), D7 will be a 0 and D6 will be a 1 and for 2 pulses (logic 0), D7 will be a 0 and D6 will be a 0.

4.2.2.4 Print Head Drive (U31, U37, U35, U36, U41)

The Print Head Drive circuitry is used to send the information to the thermal print head for printing on the left chart edge. The print head drive consists of U31, U37, U35, U36 and U41. The annotation microcomputer U31, after having accumulated all the information from the various inputs (chart speed, user inputs and time information) begins sending this information to U37. The information signals are sent one row of seven bits at a time, until all characters are printed. These characters are printed with the information appearing on U37 driving the bases of the Quad head driver transistor packs U35 and U36. The driver transistors in turn supply the power to the thermal print head.

4.3 SWITCHING AMPLIFIER BOARD (Refer to Schematic 293618)

The Switching Amplifier Board delivers the analog sine waves to the motor to make it move. This is a unipolar pulse width modulated amplifier with four outputs - one for each coil. This board consists of four sections - the sawtooth generator, the error amplifier, the pulse width modulator, and the power section.

The basic theory is to modulate the current in the motor coil by driving it with pulses of constant amplitude and frequency and varying pulse width or duty cycle. This allows an analog current waveform in the motor without the heat generated by an analog power amplifier.

4.3.1 Sawtooth Generator

This section consists of current source U501 pins 1, 2 and 3, Q509 and R503; and voltage comparator U502 pins 9, 8 and 14, Q510 and Q511. The current source develops a constant current at the collector of Q509 of approximately 1.88 mA causing C503 to charge in a linear fashion. When the voltage across C503 reaches the reference voltage of the current source (approximately 10V) U502-14 will switch high causing Q510 to short out C503 bringing the voltage toward zero. U502-14 also turns on Q511 causing the voltage at U504-8 to drop to 0V +1 diode drop. When C503 gets lower than U502-8, U502-14 switches low again allowing C503 to recharge. The net result is a linear sawtooth signal at about 10V peak and about a 20 KHz rate. This sawtooth is the reference for the pulse width modulator.

4.3.2 Pulse Width Modulator and Error Amplifier

There are two Pulse Width Modulators and two error amplifiers - one for coils 01 and 03 and one for coils 02 and 04. The error amplifiers compute the difference between the input voltage and the output current as sensed at R558 and R531, and send the error signals to U502-11 and U502-5, respectively. U502 is a quad voltage comparator. The reference signal appears at U502-10 and U502-4 respectively. Since the operation of both circuits is identical, only one will be described.

When the sawtooth reference drops to 0 volts, the input at pin 11 of U502 is greater than pin 10, and the output at U502-13 goes high, turning on the output transistor Q501 or Q503. This situation continues until the ramp reaches the voltage at U502-11. U502-13 then goes low, turning the output off again. Since the ramp is linear, the amount of time the output is on will be proportional to the size of the error signal, thus giving the pulsewidth modulation.

4.3.3 Power Section

The Power Section is constructed in two halves - one half drives coils 01 and 03, and the other drives 02 and 04. Since both halves are identical, only 01 and 03 will be discussed.

The pulse width modulated input is that of a full-wave rectified sine, and the cycles alternate between 01 and 03. The SIN GATE determines which phase is driven on a given cycle. If SIN GATE is high, U503.7 is low turning off U506.1, and allowing the PWM signal to drive U505.1 and, ultimately Q501 or 01. U503.14 will be off turning on U506.14 and shorting PWM to U505.14 turning Q503 and 03 off. Furthermore, U504.1

will be on turning U505.7 on which turns Q502 on and puts catch diode CR05 in the circuit. This diode swallows the inductive transients from the motor winding and must be present when the coil is driven. However, coils 01 and 03 form a 1:1 transformer so that catch diode must be disconnected when the coil is not driven or a current path exists for induced current causing heating and loss of power in the motor. This is the function of Q502 and Q504.

Operation of the circuit is swapped when SIN gate is low, i.e., Q503 and Q504 are on and Q501 and Q502 are off.

4.4 CONTROL TIMER BOARD (Refer to Schematic 294131)

The Control Timer Board is mounted in the card cage in the rear of the recorder. It contains branch fuses, Start/Stop Relay K701, +5 VDC and +28 VDC power supplies and Event Marker Timers.

It is responsible for turning the ink solenoid (on ink writing models), the drive amplifiers and the event markers on and off. This is accomplished thru relay K-701. The relay common is interrupted if the stop button is depressed, or if the interlock lamp is on (paper out). This opens the relay, and pins 7, 8 open the Event Marker ground. This ground is also used by the opto-isolators on the drive amplifiers to enable the output stages. Pins 4 and 5 of K-701 interrupt AC to the ink solenoid on ink writing models.

The Event Marker Timer is formed by U701, U702, U703, U704 and S702. This circuit is simply a counter chain giving various repetition rates depending on which of the six switches in S702 is closed. The settings are as in Table 4-7.

Fuses are provided to protect each power branch. Table 4-6 shows fuse and circuit protected; Table 5-1 gives the fuse part numbers and values.

When energized, one set of contacts of DPDT relay K-701 controls power to the standard event markers and optical couplers located in the pen drive amplifiers. It is energized when the chart STOP pushbutton is released. When de-energized, the set of contacts inhibit the event markers and optical couplers in the pen drive amplifier(s).

The Control Board contains two DC power supplies: +28V and +5V. The +28 VDC power source is obtained from bridge rectifier CR702 and control transformer T109. The unfiltered section of this supply provides power to relay K-701, optional event marker solenoids, and the indicator lamps. The filtered section of this supply provides power to the standard event markers to insure accuracy when precise time events are required. The +5 VDC power source is obtained from the power supply board. This supply is filtered and regulated to provide power for the pen drive amplifier optical couplers and timer.

Pulsating DC voltage is provided from bridge rectifier CR701 to operate the ink supply solenoids (ink writing units only).

4.5 POWER SUPPLY BOARD (Refer to Schematic 296449)

The Power Supply generates the voltages used by the chart drive and annotation systems. The voltage and maximum currents supplied are:

		Regulator Chip No.
1.	+22V unregulated @1.8 A	----
2.	+5V regulated @600 mA	U3
3.	-5V regulated @20 mA	U5
4.	+10.8V regulated @3.0 A	U4
5.	+15V regulated @70 mA	U1
6.	-15V regulated @80 mA	U2

There is also a relay to interrupt the +5V and +22V if a paper out condition occurs.

4.5.1 Battery Charger

The Battery Charger is a constant current charger that charges a NI-CAD battery at a 14 hour charge rate of 53 mAH. The battery charger circuit consists of U6 and R1. The regulator U6 is an LM 317 adjustable regulator with its sense pin U6 pin 1 and R1 regulating the current.

4.5.2 Voltage Sensing

The Voltage Sensing Circuit monitors the voltage of the battery which supplies the back-up voltage for the annotation processor system. If the battery

TABLE 4-5 (Baud Rate Table)

BAUD RATE SELECT (SW2)

Switch No. 6 5 4	Frequency (Hz)	Baud Rate
0 0 0	2,400	300
0 0 1	4,800	600
0 1 0	9,600	1,200
0 1 1	19,200	2,400
1 0 0	76,800	9,600
1 0 1	115,200	14,400
1 1 0	153,600	19,200

TABLE 4-6 FUSE VS. CIRCUIT PROTECTED

FUSE	CIRCUIT PROTECTED
F701 - F708	Analog Channel Power Transformers T101 to T108.
F709	Control Transformer T109 which supplies power for the +5V and +28V DC power supplies.
F711	Pen Heat Transformers T301 to T304.
	NOTE: See Table 6-1 for fuse values and part numbers.

TABLE 4-7 EVENT MARKER TIMING

REPETITION RATE	SETTINGS SW ON	SW OFF
0.1 SECOND	1, 3	2, 4, 5, 6, 7, 8
1.0 SECOND	1, 4	2, 3, 5, 6, 7, 8
10.0 SECONDS	1, 5	2, 3, 4, 6, 7, 8
100.0 SECONDS	1, 6	2, 3, 4, 5, 7, 8
.01 MINUTE	2, 3	1, 4, 5, 6, 7, 8
0.1 MINUTE	2, 4	1, 3, 5, 6, 7, 8
1.00 MINUTE	2, 5	1, 3, 4, 6, 7, 8
10.00 MINUTES	2, 6	1, 3, 4, 5, 7, 8

voltage falls below 4.0V the battery is removed from the load to prevent it from going into the deep discharge state. The voltage sensing circuit consists of U7, Q1, Q2, R6, R7 and other associated discrete components. Resistors R6 and R7 provide a voltage divider that monitors the battery voltage. An Op-Amp U7 is used as a comparator which senses the voltage divider on its non-inverting input U7 pin 3. When the battery voltage falls below the two diode drop, D5 and D6 sensed on the op-amp inverting input U7 pin 2, Q1 is turned off which turns off Q2 and disconnects the battery from the load.

4.5.3 Thermal Head Protection

The Thermal Head Protection circuit protects the thermal print head from damage if power is supplied to the print head for more than 800 μsec. The thermal head protection circuit consists of U4, U8, U11, U12, U10, U9, U13 and Q3. When the thermal print head is printing information, the head protection line J3 pin 1 is pulled low. This low is sensed by comparator U8 pin 2 which then allows counter U10 to count by releasing its reset pin 7. The counter begins counting the 12.5 KHz pulses generated by U11. If the counter reaches 10, the head has been on for 800 μsec and the head drive voltage must be shut down.

The logical high on U9 pin 11 is routed to the base of Q3, turning it on. Turning Q3 on causes regulator U4's output to drop from 10.8 volts to 1.25 volts. In addition, the high on one shot U13 pin 4 causes the output U13 pin 6 to go high for 6.8 ms. The delayed high is sufficient to allow the output of U4 to be held down at 1.25 volts long enough for U12 pin 3 to go low which disables U10.

The delay of one-shot U13 prevents the possibility of having the head turned on repeatedly for 800 μsec and off for only a few gate delays (approximately equal to 50 nanoseconds) which would cause damage to the head.

4.6 OPTICAL SENSOR BOARD (Refer to Schematic 294133)

The Optical Sensor Board provides gross motion detection to the processor. The motor damper has eight non-reflective lines on it. The optical sensor monitors these lines, and output a pulse from its buffer transistor each time one is detected. If they arrive at too low a rate, the logic on the Chart Control Board will interrupt the processor. This interrupt is ignored unless the selected speed is 200 mm/sec.

4.7 SPEED SELECT BOARD (Refer to Schematic 293620)

The Speed Select Board is mounted on the left side of the front panel. It contains the operator control switches for POWER ON/OFF, CHART SPEED selection, and EVENT Marker actuation; and indicators for POWER ON and INTERLOCK.

The POWER switch is a set-reset pushbutton which interrupts both phase and neutral sides of the AC power line.

Chart speed selection is made by depressing one of six SPEED, a DIVIDE, or STOP pushbutton. The SPEED and STOP pushbuttons are mechanically interlocked to reset a previously selected pushbutton. The DIVIDE is a set/reset pushbutton. A combination of four binary outputs is activated by the SPEED pushbuttons to obtain the desired chart speed.

Each chart speed may be divided by 60 or 100 or 1000* (depending upon divide by switch settings on the Processor Board) by depressing the DIVIDE pushbutton. The STOP pushbutton interrupts power to the motor via relay K-701 on Control Timer Board and resets the SPEED pushbuttons.

When the LEFT or RIGHT MARK EVENT pushbutton is depressed, solenoid L108 or L109, respectively, are energized activating the left or right event markers. These are momentary pushbuttons, and are reset when released.

***NOTE: Divide-by-1000 speed should not be used in ink writing recorders due to excess ink bleeding at such low speeds.**

The Speed Select Board contains the speed selection logic. The two multiplexers on the board (74LS157); U602, U604, select either the front panel switches, or the rear panel remote connector. The select line for the MUX; U602, U604 pin 1, is high for local and low for remote, and is driven from the rear panel. The four signals K101, K102, K103, K104, are the chart speed code. The code is listed below in Table 4-8.

The stop signal (pin 19) is used by the Chart Control Board to generate a reset to the processor. In local mode, it comes from the stop switch thru U604 pin 13. In remote it comes from U601-6

TABLE 4-8 REMOTE SPEED CODES

S1	S2	S3	S4	SPEED (divide by selectable by SW2 on Processor Board) Divide by 100	Divide by 60	Divide by 1000
0	0	0	0	200mm/sec	200mm/sec	200mm/sec
0	0	0	1	100mm/sec	100mm/sec	100mm/sec
0	0	1	1	50mm/sec	50mm/sec	50mm/sec
0	0	1	1	25mm/sec	25mm/sec	25mm/sec
0	1	0	0	EXT PULSE	EXT PULSE	EXT PULSE
0	1	0	1	10mm/sec	10mm/sec	10mm/sec
0	1	1	0	5mm/sec	5mm/sec	5mm/sec
0	1	1	1	STOP	STOP	STOP
1	0	0	0	2mm/sec	200mm/min	.2mm/sec
1	0	0	1	1mm/sec	100mm/min	.1mm/sec
1	0	1	0	.5mm/sec	50mm/min	.05mm/sec
1	0	1	1	.25mm/sec	25mm/min	.025mm/sec
1	1	0	0	EXT PULSE	EXT PULSE	EXT PULSE
1	1	0	1	.1mm/sec	10mm/min	.01mm/sec
1	1	1	0	.05mm/sec	5mm/min	.005mm/sec
1	1	1	1	STOP	STOP	STOP

LOGIC 0 = .8V max
LOGIC 1 = 24V

when the proper code for stop is present on S2, S3 and S4. The relay signal (pin 14) turns on relay K-701 on the Control Timer Board. If Q603 is off, the relay is off, interrupting the event marker ground and turning off by either a stop condition, paper out condition, removal of the remote link, or grounding the stop pin (pin C). In local mode, the stop condition is sensed thru U604-13 from the stop switch. In remote, it is thru U601-8 in conjunction with U601-6. If a paper out condition occurs, K-701 on the Control Timer Board opens, interrupting the event marker ground (pin 6) and allowing Q601 to turn on and ground enable. The processor then is unable to find a speed, and the chart stops.

4.7.1 Thermal Writing Recorders Pen Heat Control

The thermal writing recorders also have a Pen Heat Control circuit. The purpose of this circuit is to heat the pens proportionally with chart speed, giving more even trace density.

The STROBE OUT signal (U607-3) is integrated by R634 and C606. Since this signal is a pulse of constant width and varying frequency, the DC voltage at C606 will be proportional to the freq-uency of STROBE OUT and therefore, to chart speed.

The AC reference signals (pins Y and Z) are rectified by CR607. The comparator U606 will give a negative pulse out whenever the rectified AC reference approaches 0V. The result is a 120 Hz pulse train synchronized to the AC line. When this pulse is low, Q605 turns on shorting C605 to +15V. When the pulse goes back high, C605 begins to charge toward -15V at a rate determined by R626, generating a negative-going ramp. When the value of this ramp as seen at comparator U606-10 is less than the integrated chart speed voltage at U606-11, U606-13 will go high. The leading edge of this pulse is passed to Q607 by C607 turning on opto-isolator U605. This in turn turns on Q604 causing gate current to flow in Triac Q606. Q606 turns on, causing AC current to flow in the pen heat transformers.

4.8 VARIABLE SPEED BOARD (Refer to Schematic 293621)

The Variable Speed Board is used to reduce the step clock frequency in order to slow the chart speed by up to 2.5 times from the calibrated speed settings. The Variable Speed Board consists of a potentiometer/switch. The potentiometer reduces the 5 Volts to the summing junction of the step clock circuit as discussed in 4.2.1.1. The switch performs two functions, first it tells the Micro-stepping and Annotation Processor Systems that variable speed is being initiated, next it supplies 5V to light an LED indicator on the front panel of the recorder for uncalibrated chart speeds.

4.9 CHART SPEED SYSTEM SOFTWARE

The System Software is broken up into three basic modules:

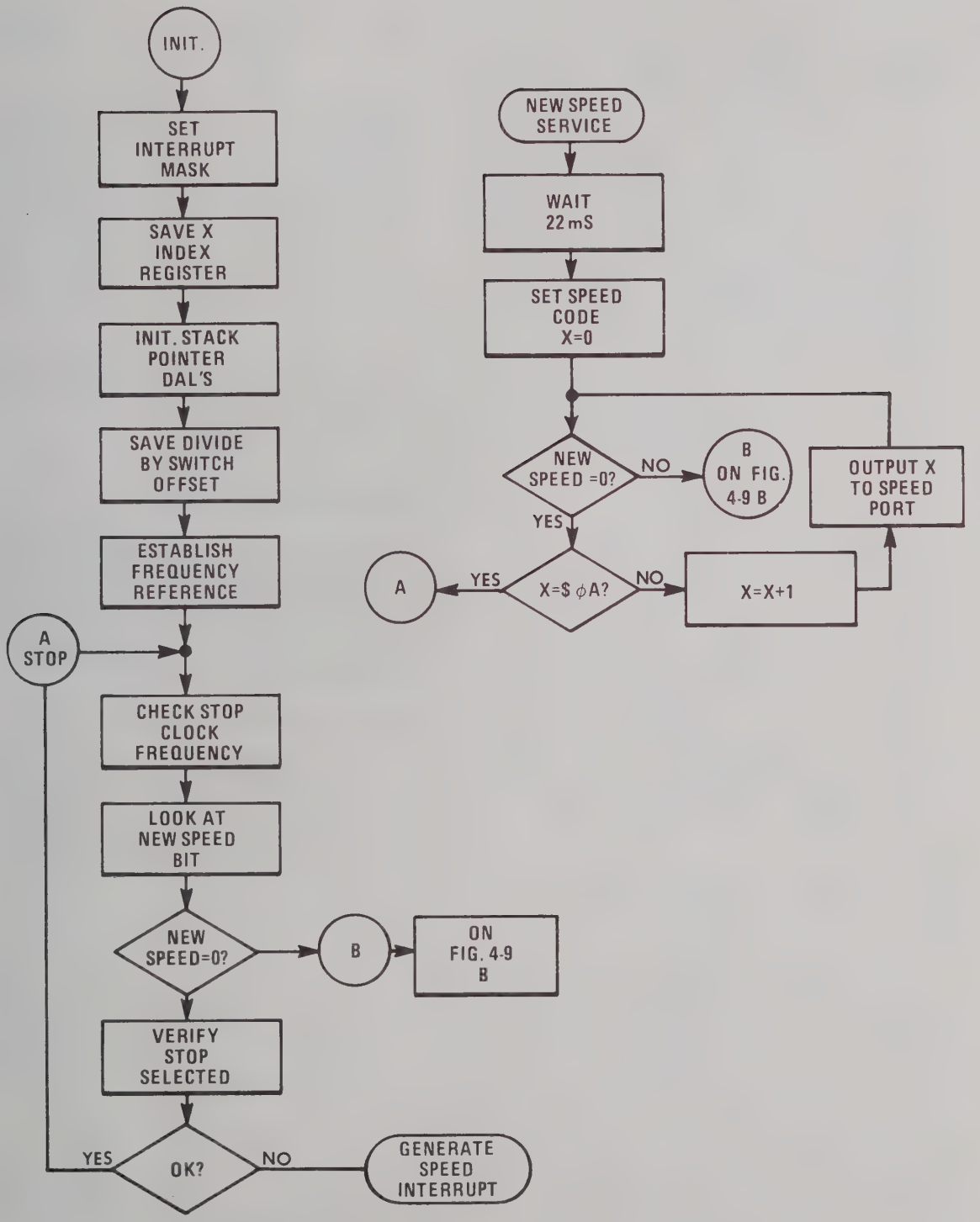
Speed Decode/Select, Speed Generation and Step Clock Frequency Tracing. The latter two modules are active concurrently and the former is active only when a speed change occurs or when the recorder is stopped.

The starting address of the software is $7000.

4.9.1 Speed Select/Decode

All the chart speeds are selected by counting the step clock signal. The Speed Decode software reads the speed code, and converts it into an index. It then reads from ROM the number of step clocks to ignore before taking a step using the index as a pointer to the Look-Up Tables. These values are stored in two locations of scratchpad RAM for use by the Speed Generator Routines (locations FACTH, FACTL and CONSTH, CONSTL). Refer to Flow Chart, Figure 4-8 for operation of this module.

Whenever the speed is changed, the hardware generates a reset to the Microstepping Processor. The processor in turn begins to search for the correct speed code to run the chart. It does this by first looking at U26 for the divide-by speed code selected and then stores this code for later use in



bi 2588

FIGURE 4-8 SPEED SELECT FLOWCHART

determining which of the three Speed Reference Tables to use (see Figure 4-8). It next outputs a 0000 to U5 and checks the NEW SPEED line U5 pin 21 to see if that is the correct speed code, signaled by NEW SPEED line going high. If it is, it goes to the Speed Decode Routine (see Figure 4-9). If it is not, it increments the code to U5 and checks the NEW SPEED line again. This process repeats until the correct code is found, or until all possibilities are exhausted. In the latter case, the processor returns to the Stop Routine (Figure 4-8, Point A) where the frequency of the Step Clock is checked. If the NEW SPEED line is now high the processor returns to the Speed Decode Routine (Figure 4-9) and repeats the entire process. The Stop Routine is decoded for the Enable Line low U5 pin 23, stop selected, the remote link removed, a remote stop selected or the interlock activated.

The speed decoded (Figure 4-9, Point B), uses the switch setting established by U5 and U26 to generate the correct speed. The Speed Code is put in the Index Register. This number is decremented and multiplied by 2, then the divide-by offset is added to give a compact, efficient structure to the Speed Look-Up Tables. The Index Register is now the pointer to this table. The processor fetches the correct speed constants from the table using an indexed load, and stores them twice in RAM. Each constant is two bytes and represents the number of Step Clocks to count before stepping. One constant is decremented to zero by the Speed Routine, and the second restores the first.

Certain speeds are handled as special cases, and these are shown at the end of Figure 4-9.

At this point, the constants have already been loaded, so the Index Register has been incremented once from its original number. If it contains a $5 or $15, this indicates that the external step mode is to be enabled. If it contains a $18, the speed is 100mm/sec, which is a special loop. If it contains a $1D, the speed is 200mm/sec, which is a special loop. If it contains a number greater than $1D, the code is invalid, and we return to the Stop Routine, and eventually attempt to re-decode it. If none of the above is true, the speed is between .05 and 50mm/sec and we go to the General Speed Loop (Figure 4-10, Point F).

4.9.2 General Speed Loop (Flow Chart Figure 4-10)

For this loop, the Y Index Register holds the low-order byte of the speed constant, and the high-order byte is in memory. The processor waits for Step Clock to go low. When it does, the Y Register is decremented and compared to zero. If it is not zero, the processor goes to the Frequency Check Subroutine (Point G, Flow Chart Figure 4-10), and then returns to wait for Step Clock to go high again.

If Y was zero, the processor decrements the high-order byte of speed constant and compares it to zero. If it is not zero, as above, we check the frequency and repeat.

If high byte is zero, then the processor steps the motor, and restores high and low byte constants.

To take a step, the processor must update the SIN and COS signals on U33 and U28 respectively. The SIN and COS Look-Up Tables are interleaved in a 256 byte section of memory. Using the Index Register X as a pointer, the processor fetches the data with an indexed load.

4.9.2.1 100mm/sec Speed Loop

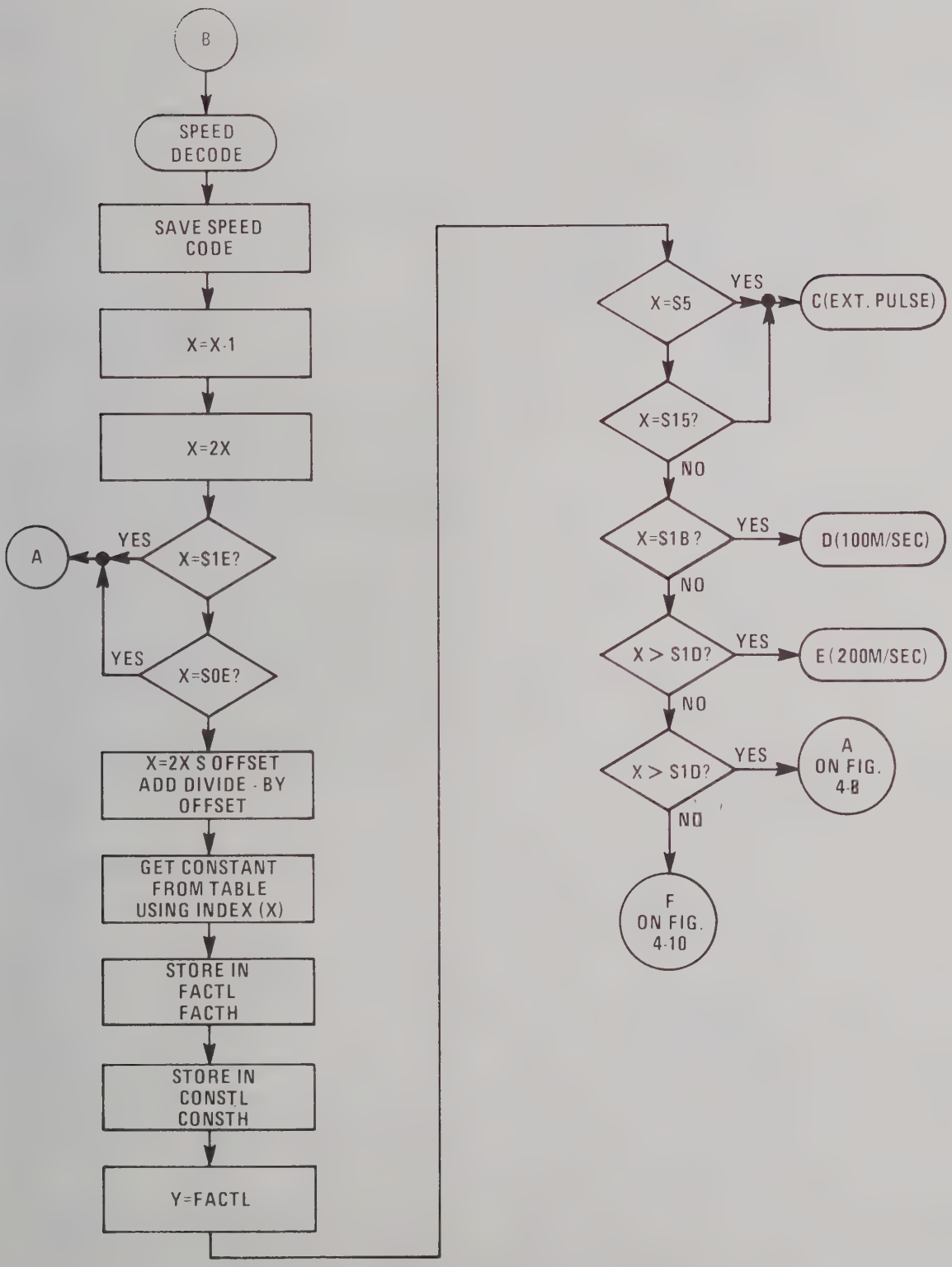
This loop operates like the General Loop except that a step is taken on each high to low transition of Step Clock. This eliminates the requirement for counting clocks and comparing counts, giving the processor sufficient time to adjust frequency at every step.

4.9.2.2 200mm/sec Speed Loop

This loop is as above, except that at every high to low transition the processor advances two entire steps through the SIN/COS Look-Up Table, reducing the micro steps to 8 and effectively doubling the motor speed.

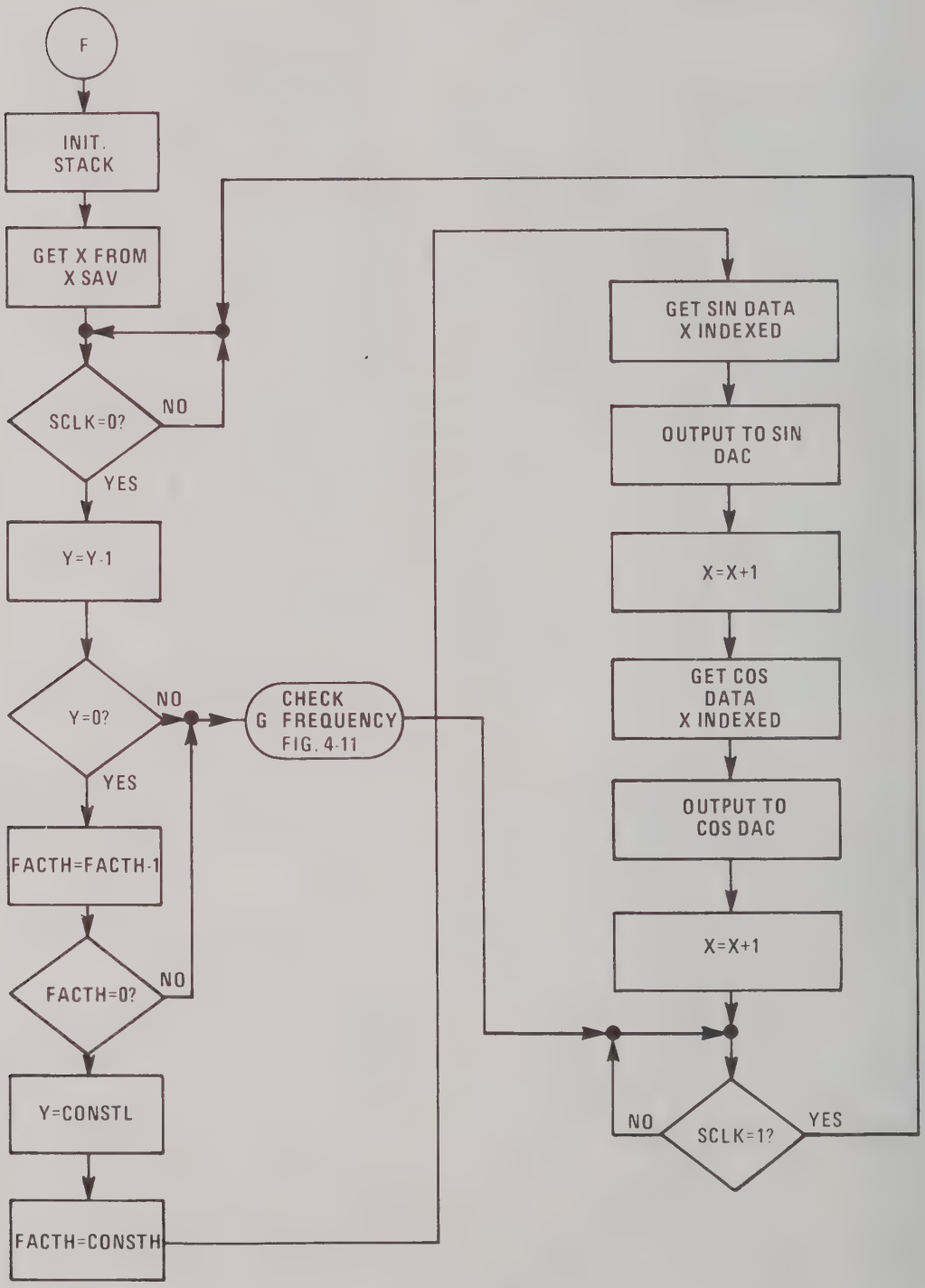
4.9.2.3 External Speed Loop

This loop steps the motor at each high to low transition of the external input. Frequency is not checked or adjusted.



bi 2589

FIGURE 4-9 SPEED DECODE FLOWCHART



bi 2590

FIGURE 4-10 GENERAL SPEED LOOP FLOWCHART

4.9.2.4 Frequency Adjust Routine (Flow Chart Figure 4-11)

The Frequency Adjust Routine allows the processor to monitor the Step Clock frequency and adjust it to eliminate time or temperature drift. This routine uses the period counter and the frequency adjust DAC (U25). The loop also effectively averages readings to compensate for noise and to prevent oscillations about the center frequency.

First, the processor checks the switch on the variable speed pot. If this is open, the recorder is in variable speed mode and nothing else is done; the processor returns.

If the switch is closed, the frequency is adjusted. The adjustment DAC is 8 bits wide, however, the processor maintains a 16 bit number to control it. Only the 8 most significant bits actually go out to the DAC. The low order 8 bits are initialized to $80.

The processor then reads the period counter's high byte and compares it with the high byte of the period reference established the last time the stop button was hit. If the two are equal, then the period counter's low byte is read and compared to the period reference low byte. In either case if an inequality occurs, the direction of the inequality is established. If the frequency is high, the DAC must be decremented. If it is low, the DAC must be incremented.

Both the increment and decrement routines work the same way, so only the increment routine will be discussed.

First, the low byte of DAC is incremented. If this generates a carry (i.e., the register overflowed from $FF to $00), then the high byte is incremented and output to the DAC. Also, the low byte is re-initialized to $80. This way, the frequency must be in error 128 ($80) readings in a row in the same direction before the DAC actually changes. This gives a filtering effect which insures that the VCO is able to settle to its final value before it is changed again.

4.10 ANNOTATION PROCESSOR SYSTEM SOFTWARE

Figure 4-12, General System Flowchart for Annotation Software is comprised of various subroutines and illustrated throughout this section with Subroutine Flowcharts. Figure 4-13 provides an Address Memory Map of U30 for Annotation Routines.

4.10.1 Power Up/Reset

Upon power up or reset in Figure 4-14, the processor will initialize the PIA interrupts (Port 1 of the processor I/O), the Real Time Clock (square wave output, dividers, and time format), the Stored Time Buffer, and the RS232C Interface. It will then check the Real Time Clock for a possible battery failure. If there is a battery failure some default settings will be input. Otherwise, it will proceed to the main program.

4.10.2 Default Settings

If the Battery Power fails for any reason, the Test No. Buffer will be set to an 00, only CHART SPEED printing will be enabled, the MESSAGE buffer will be cleared, U.S. DATE format will be selected, ANNOTATION will be enabled, and the TIME and DATE buffers will be cleared. The program will then proceed to the main program.

4.10.3 Main Program

This section of the program in Figure 4-14, controls and formats all information for printout. It is also used to service the NMI Routine (Figure 4-15), which is called upon for a change of speed. As a precaution, the first step clears the print heads to prevent their destruction, if they were on when called out of the print routine. It also re-initialized the Stack Pointer since the unit will not be returning to any subroutine it may have been in.

During the NMI Service Routine, Figure 4-15, the processor will determine what the new chart speed is by reading the front panel switches, or external input code K101, K102, K103, K104 and decode the chart speed. It will also calculate the print spacing required for consistent spacing at all speeds. On returning from the NMI Routine, Figure 4-15, to Reset Routine, Figure 4-14, the spacing will be stored as a Time of Delay and a multiple of the fundamental delay. The variable speed potentiometer on the front panel is then checked for detent. If it is in detent the next section will be bypassed. If it is not in detent a new speed and print spacing must be calculated in Figure 4-16. To accomplish this, the subroutine

uses the Free Running Counter and the Input Capture Register in the processor and the 5-16 KHz signal generated from the variable speed pot as an input (see 4.2.1.1). The Free Running Counter is used to measure the pulse width of the 5-16 KHz signal by capturing the count on negative going transitions and finding the difference between the subsequent counts. This is done five times and an average is taken. From this count a proportion is figured into the fundamental delay, the number of fundamentals is not altered, and the variable speed itself is calculated, formatted, and stored in memory for output.

4.10.3.1 Time

From this point on the formatting and printing of enabled information takes place in the Print Routine, Figure 4-17. First the Stored Time Flag is checked to determine if there is a "STORED TIME TO PRINT". If it is set there is no stored "TIME" to be printed. If it is not set it branches to a delay, to allow the chart to get up to speed, if it is being operated externally from a waveform recorder. The stored TIME is then formatted for printing (it is flagged on the chart paper with a printed asterisk "*"). After the stored waveform trigger time is printed on the chart the PIA interrupt flag is reset and the PIA interrupt is re-initialized. The "FLAGS" Register is then checked for the TIME PRINTING ENABLED bit. If it is set the "TIMER" routine checks to see if TIME is from IRIG or the REAL TIME CLOCK and formats the proper time for printing. If the REAL TIME CLOCK is used, an update status bit is first checked in the clock. If the bit is cleared it is possible to retrieve the TIME information. The TIME information which is in BCD is converted to ASCII and stored in an Output Buffer for printing with other formatting information. If IRIG is being used, the IRIG information is decoded, converted to ASCII and also stored in an Output Buffer for printing. The "TIME" is printed, position on the chart is indicated by a timing mark (1). After the timing mark, the word "TIME" is printed and then the real time is printed. If the time bit is not set or after the time is printed, the "DATE" printing enabled bit in "FLAGS" is checked.

4.10.3.2 Date

If the Date Print Enable bit (Figure 4-17) is set, the "DATE FORMAT ROUTINE" is called to format the DATE. First, the update status bit in the REAL TIME CLOCK ($100A) is checked. If the bit is set, the processor waits, otherwise it reads the Month at $1008. From this BCD month reading $01 is subtracted then it is multiplied by 3. This number is used as an offset in the MONTH Table. This address is stored temporarily as the FLAGS are checked for the U.S./European date formats. If the U.S. format is selected, DATE will be formatted as month-day-year and the daylight savings function will be enabled. If the European format is selected, DATE will be printed day-month-year and daylight savings will be disabled. When the day and year are read from the REAL TIME CLOCK ($1007 and $1009 respectively) they are converted from BCD to ASCII before being stored. Before the DATE is printed the word "DATE" is printed. Dashes are used to separate month, date and year. The month is printed as a three character mnemonic (i.e., JAN, FEB, MAR, etc). After the DATE print sequence, the program continues on to check the Chart Speed Printing Enabled flag.

4.10.3.3 Speed

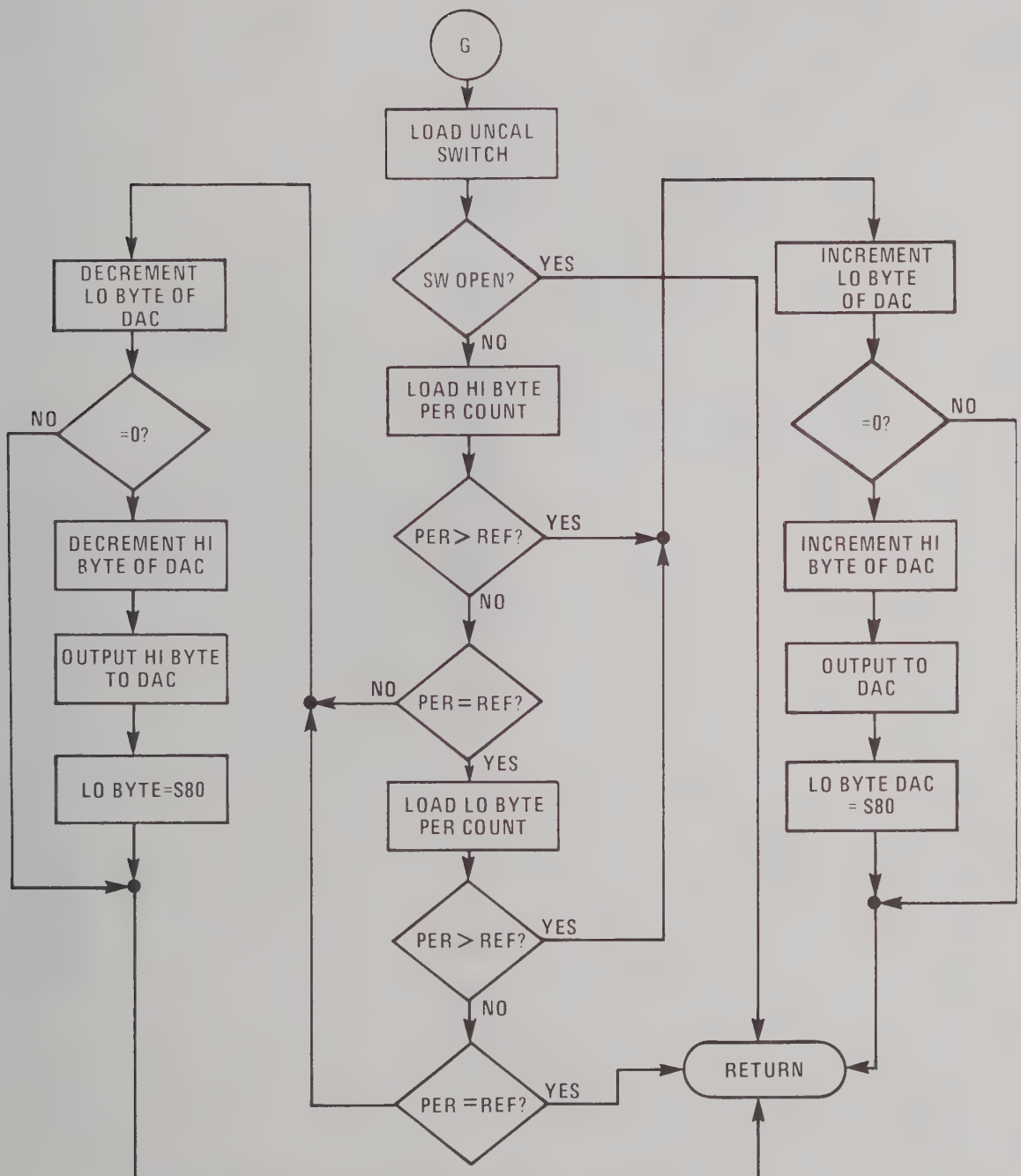
If the Chart Speed Print Enable bit (Figure 4-17) is set, the message "SPEED" is printed on the chart and the Speed Format Routine is called. This routine checks if the unit is in detent. If it is the "SPEED" is loaded from the address in "SPEED ROUTINE" to "OUTPUT BUFFER" for printing. If it is not in detent, the variable speed is loaded into the OUTPUT BUFFER. The speed is then printed and FLAG1 is checked for the divide-by selected. If the unit is in divide-by 60, "MM/MIN" will be printed, otherwise "MM/SEC" will be printed. After the SPEED sequence, the program continues on to check FLAGS for the MESSAGE PRINTING ENABLED bit.

4.10.3.4 Message

If the Message Print Enabled bit (Figure 4-17) is enabled, a space will be printed, then the message which is stored at "MESSAGE BUFFER" will be printed. After the message is printed or skipped, the program will look at FLAGS again to check if TEST NUMBER PRINT bit is enabled.

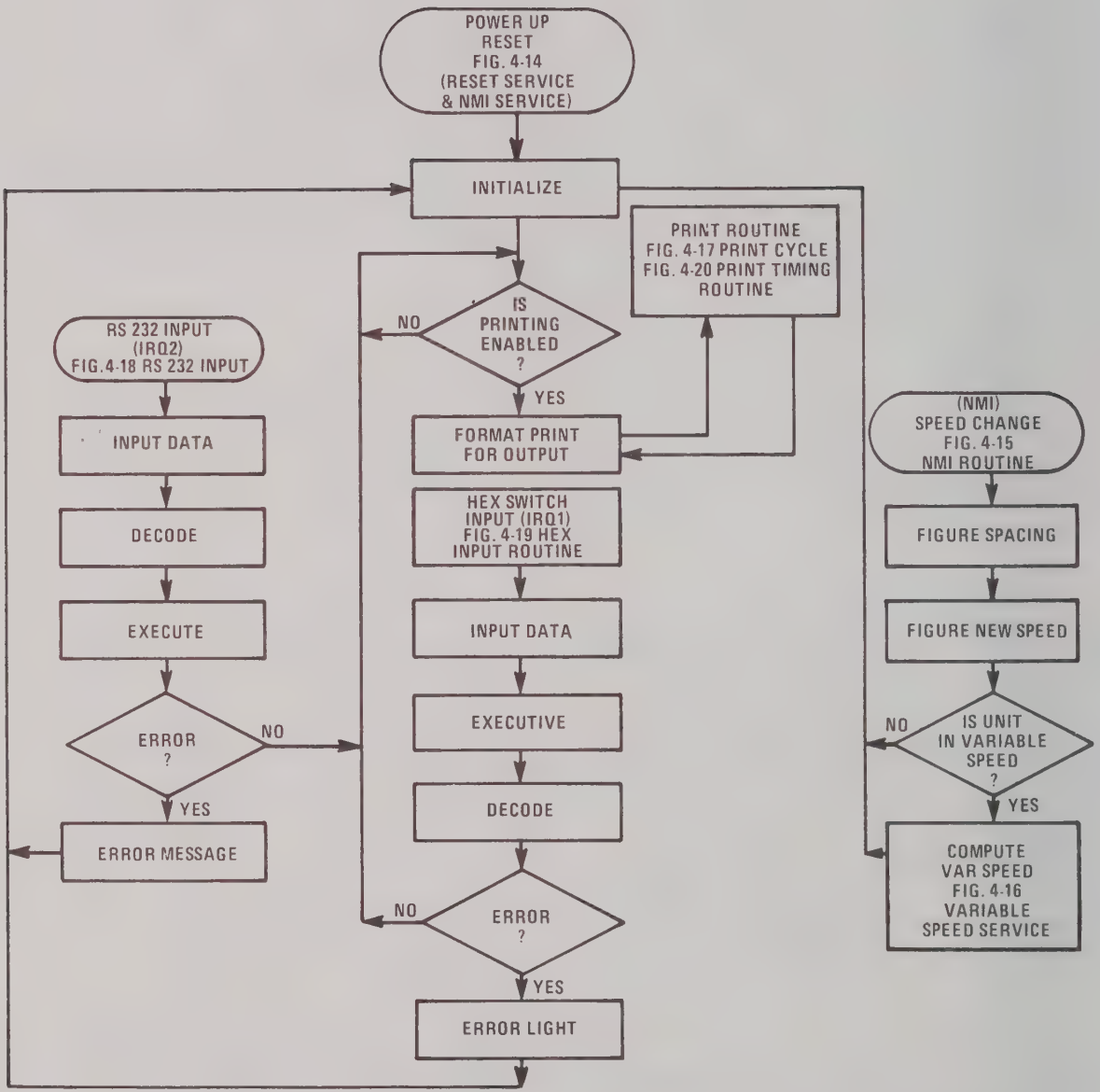
4.10.3.5 Test Number

If the Test Number Print bit (Figure 4-17) is set, the message "TEST NO" will be printed and then the test number, which is stored as ASCII characters



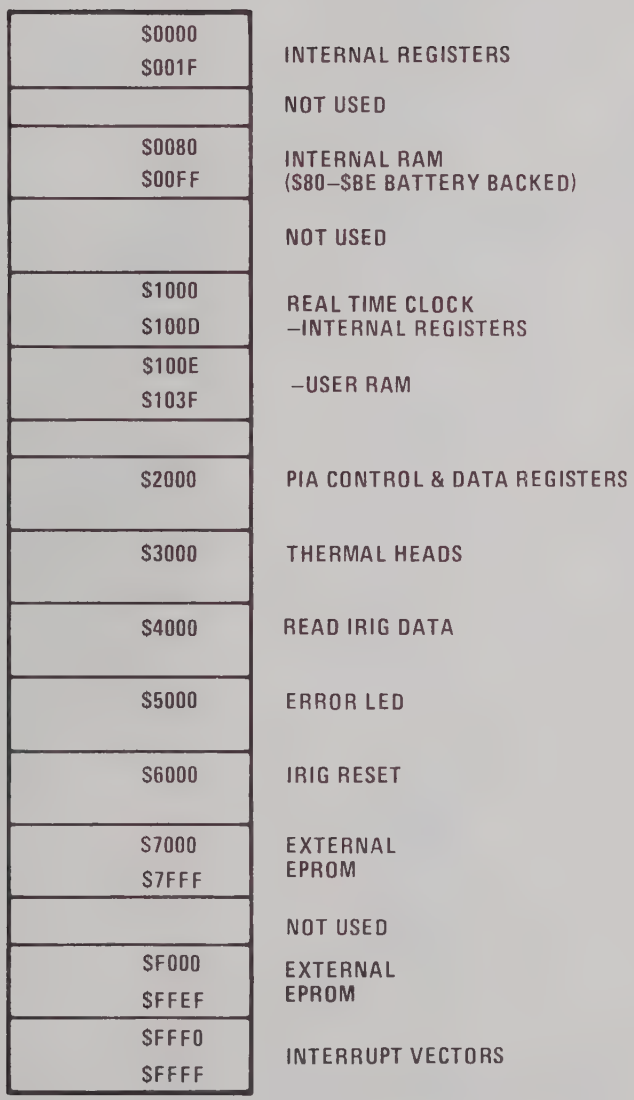
bi 2591

FIGURE 4-11 FREQUENCY ADJUST ROUTINE FLOWCHART



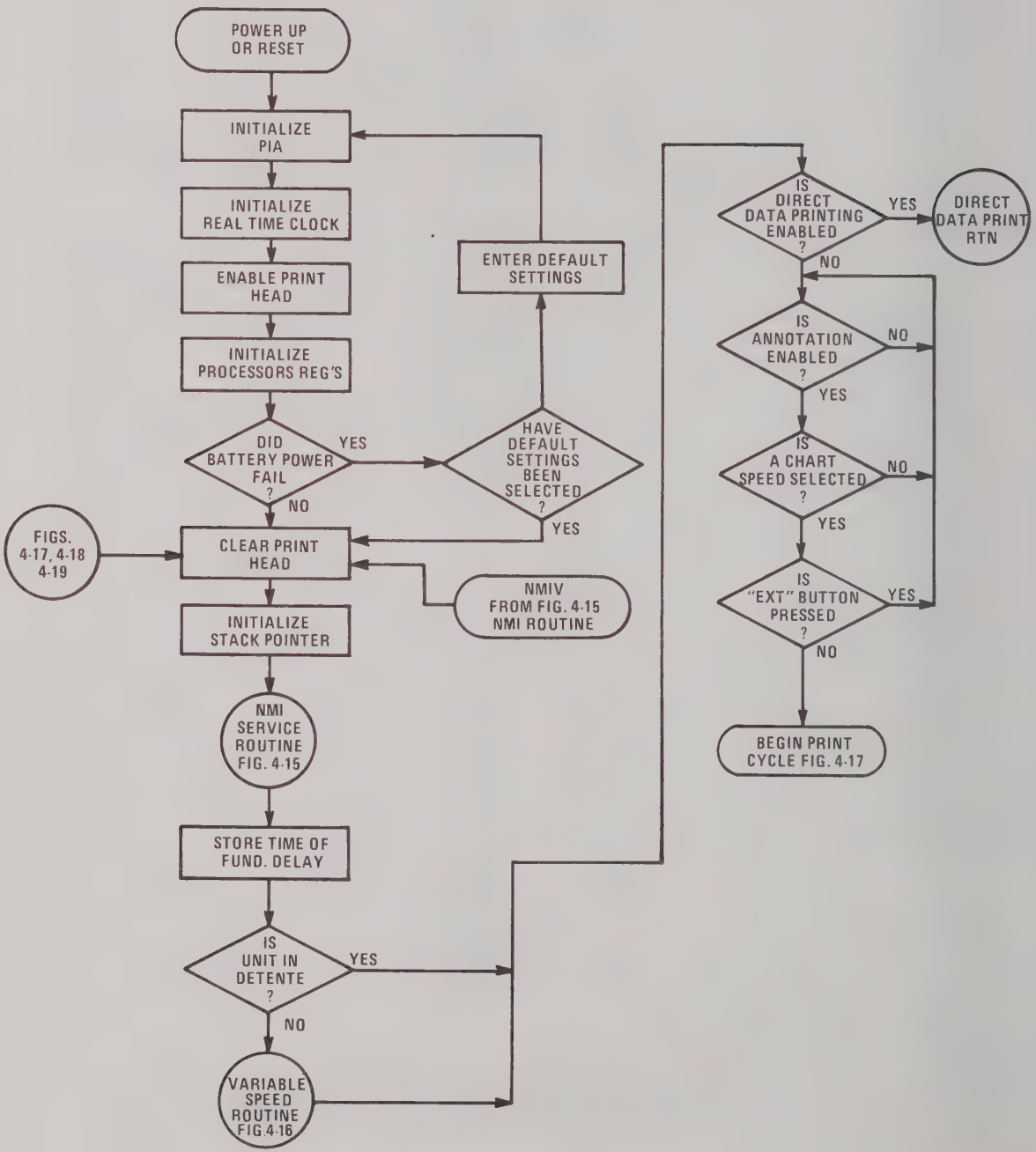
bi 2592

FIGURE 4-12 GENERAL SYSTEM ANNOTATION SOFTWARE FLOWCHART



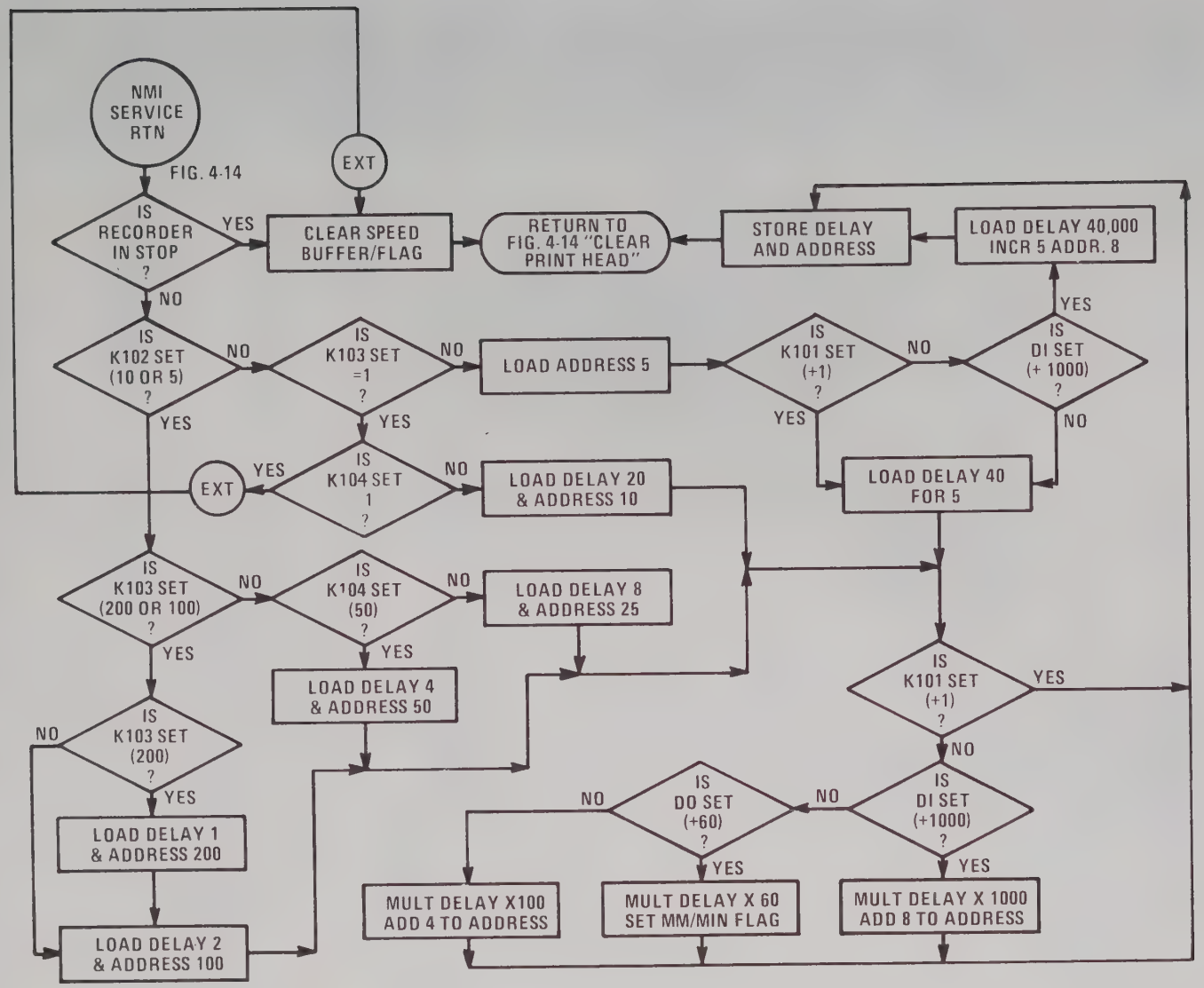
bi 2593

FIGURE 4-13 MEMORY MAP



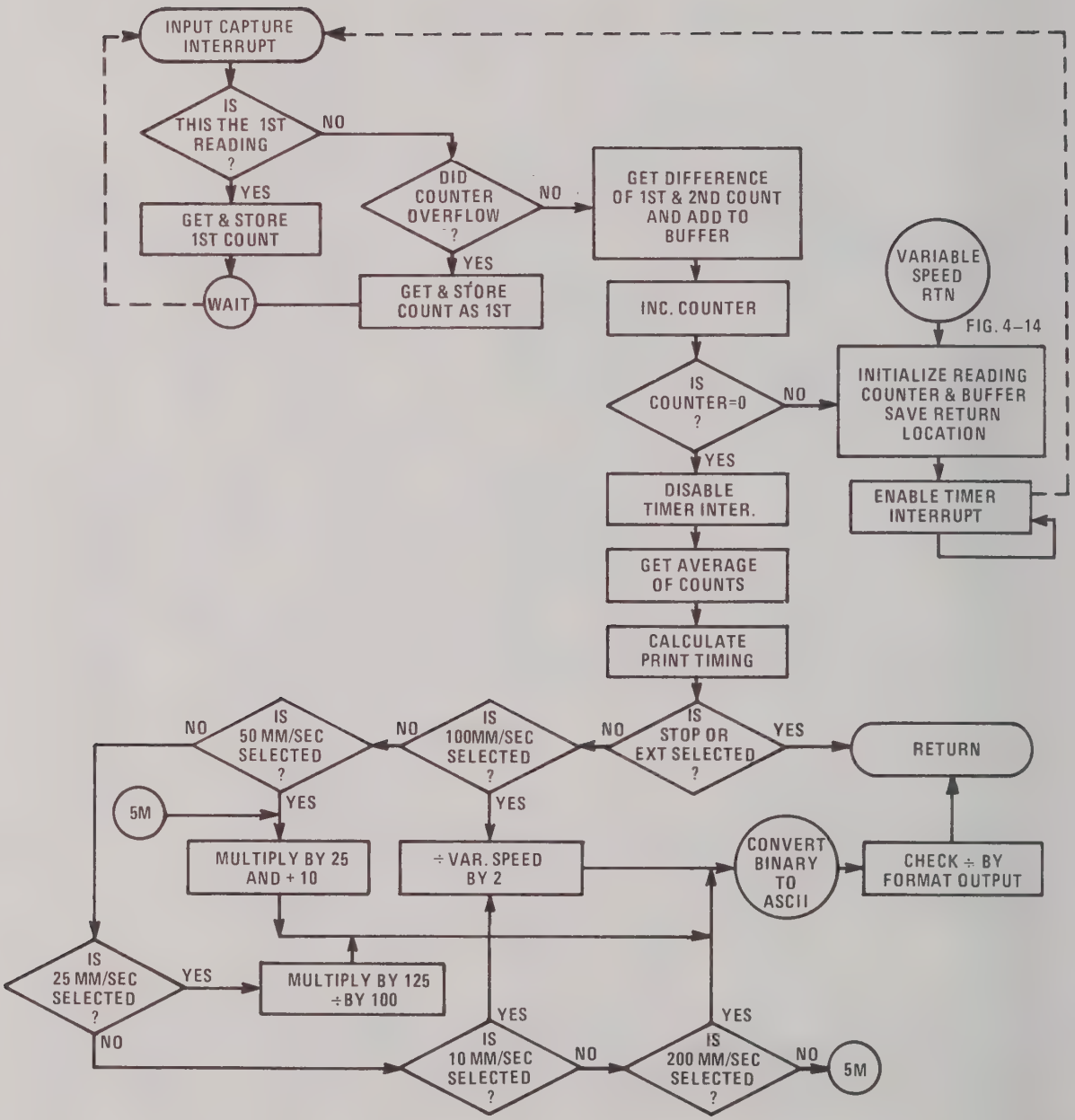
bi 2594

FIGURE 4-14 RESET AND SERVICE ROUTINE FLOWCHART



bi 2595

FIGURE 4-15 NMI ROUTINE FLOWCHART



bi 2596

FIGURE 4-16 VARIABLE SPEED SERVICE FLOW CHART

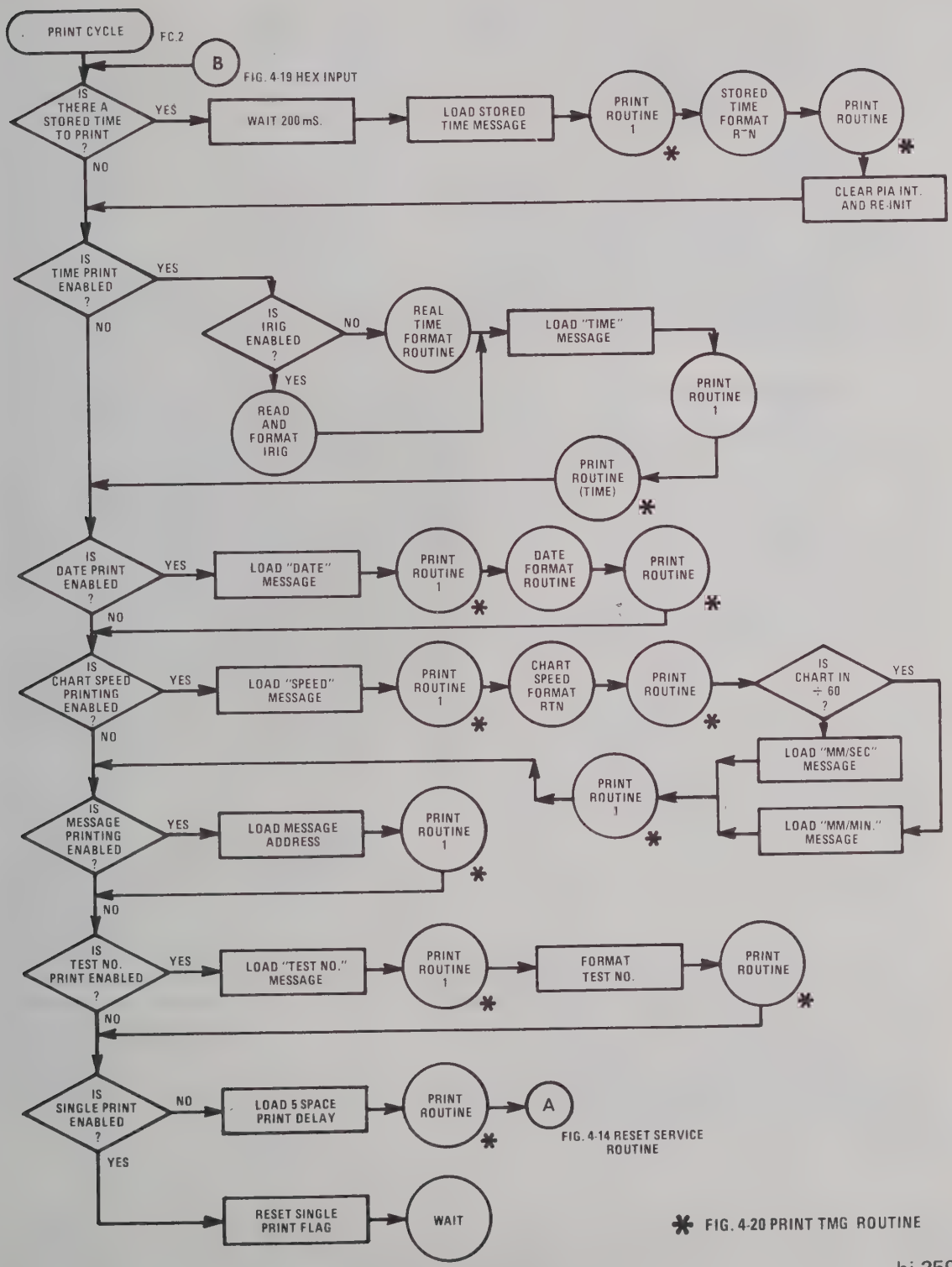


FIGURE 4-17 PRINT CYCLE FLOWCHART

in "TEST BUFFER". After the test number is printed, or if it is skipped, the next step is checking the SINGLE PRINT bit in FLAG1.

4.10.3.6 Single Print (Figure 4-17 Single Print Enabled)

If the Single Print Enable flag is set, the unit will clear the flag and go into a wait state for further instructions. If it is not set, the unit will go to a delay state where 5 spaces will be loaded to the Output Buffer and printed. The program will then return to the beginning of the MAIN PROGRAM and continue through the cycle.

4.10.4 RS232 Serial Input

The RS232 Input Routine in Figure 4-18 is a 10 bit, no parity, serial input, which operates from the serial communication interface (SCI) on the processor board at selectable baud rates of 300, 600, 1200, 2400, 9600, 14400, and 19200. The RS232 is wakened by a carriage return from a User Terminal and responds by sending a cursor (>). All inputs from this point on are echoed to the user. The acceptable character set are ASCII characters from 20 to 5F, a carriage return (0D) and a null (00). Lower case alphabetic character inputs are automatically converted to upper case. When the user enters a mistake, a delete or rubout (7F) will delete the character and be echoed to the user as a backslash (\). As each character is input to the system the 50 character input buffer is checked for remaining memory room available. If there is no room left, an error message is sent. Upon receipt of a second carriage return the program jumps to a Command Decoder Routine.

The Command Decoder Routine takes the first two characters from the input buffer and checks to see if the command is a legal command in the command table. If it is the address of the command, the two bytes following the command, are stored. If it is not a legal command, an error message is sent. The program will then jump to the address of the command and execute the command.

4.10.5 Hex Switch Input

The rear Hex Input Routine, Figure 4-19, uses the IRQ1 interrupt to input data to the processor. Upon receipt of the interrupt, some initialization takes place. The variable speed timer interrupt is disabled, the error light is turned off, and the print head is cleared as a precaution. There is then a delay of 2 msec to allow for switch bounce after which data is input to the processor and inverted. FLAG1 is then checked to see if the information inputted is a command or data. If it is data being input, the system will return to where the command that needed the data was. Otherwise, the information will be treated as a possible command.

The first check on incoming information is for a null (00). If set at 00, the Stored Time Buffer is checked for FF, if it is set, then the time on the Real Time Clock will be stored. If not set, the processor will ignore the interrupt. The next check is for the External Input Single Print Command (9B). If this is input, the program will set the single print flag and jump to begin the printing cycle. Next, the program will check if the command is within the legal command boundaries 80 through 9F, if not the ERROR LIGHT on the "SEND DATA" switch will be turned on. If the command is legal, the input is checked for data input requirements. If the command is less than or equal to a hex 87, input data will follow and a flag will be set and checked on the next interrupt. If the command is 86, Enter Message, a separate routine is called to input a message. If needed after the data is input, or after the command not needing data is entered, the command is decoded and executed. The stack pointer is then re-initialized and the program returns to the main program.

The routine for entering USER MESSAGES first checks if the buffer is full. If it is, the error light ($5000) is turned on by writing a 0 on data bit 7. None of the information previously entered will be lost. The next test is for a carriage return (0D) which will terminate the message and put a null at its end. Next test will be for a rubout character which will decrement the buffer pointer and rewrite over the wrong information and the last check is for legal characters. If character is not legal as defined above for the RS232 input, the error light will be turned on. If all tests are passed, the character is entered into the buffer and the buffer pointer is incremented.

4.10.6 Print Timing Routines

The Print Timing Routines, Figure 4-20, will print the contents of the output buffer unless the address of other information to be printed is loaded to the index register and the print cycle is entered at PRINT RTN1. The first character is

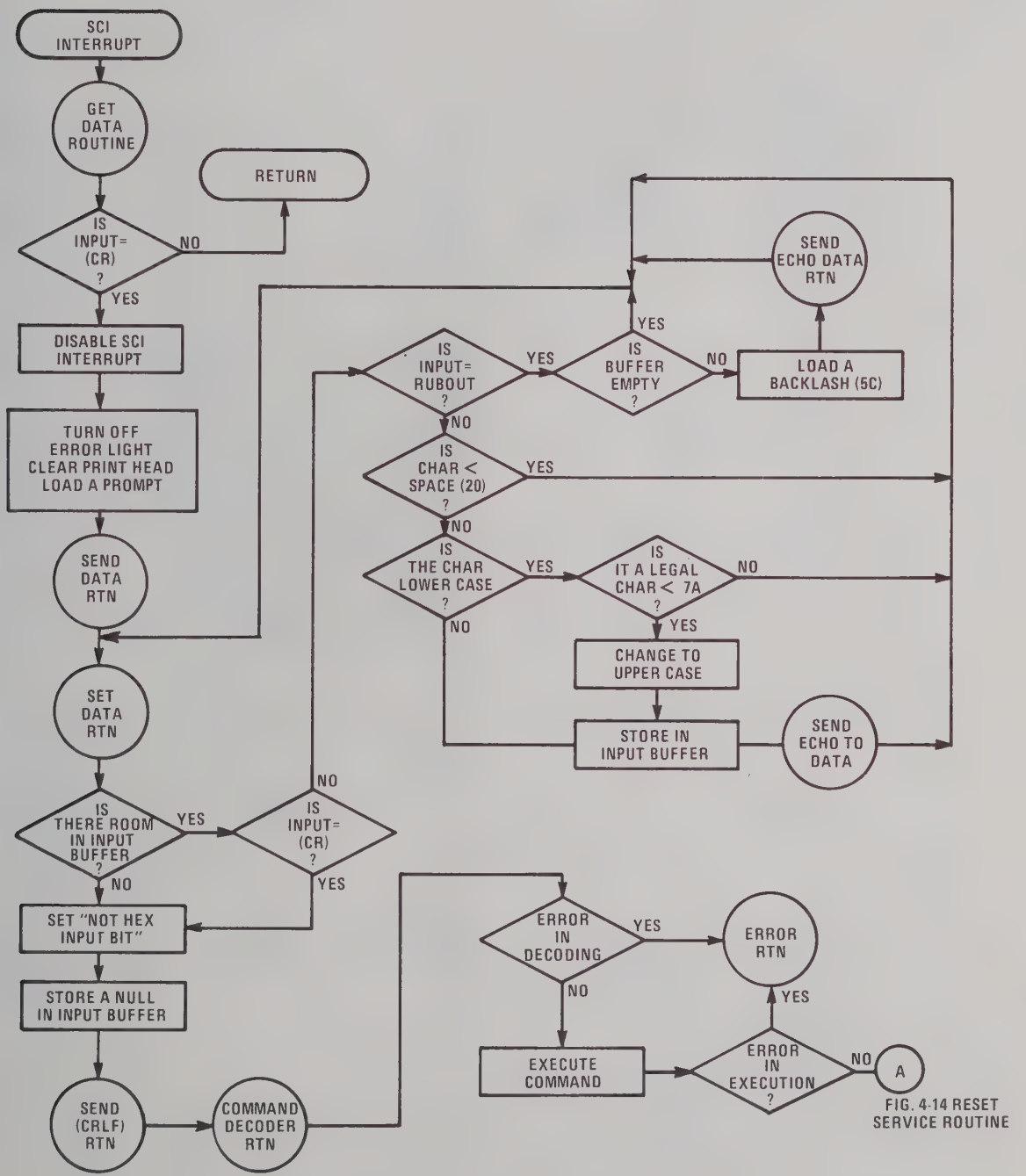


FIG. 4-14 RESET SERVICE ROUTINE

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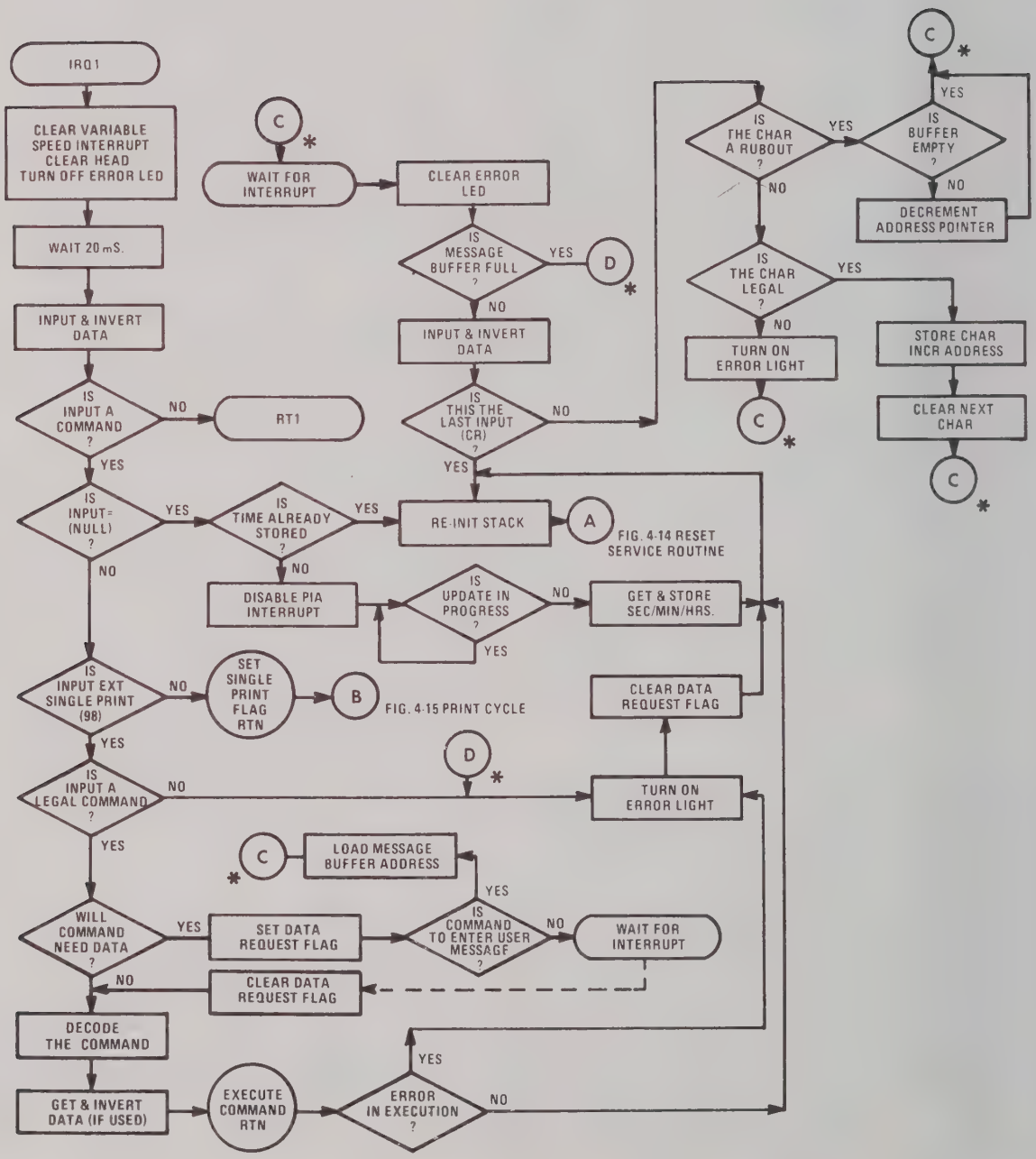
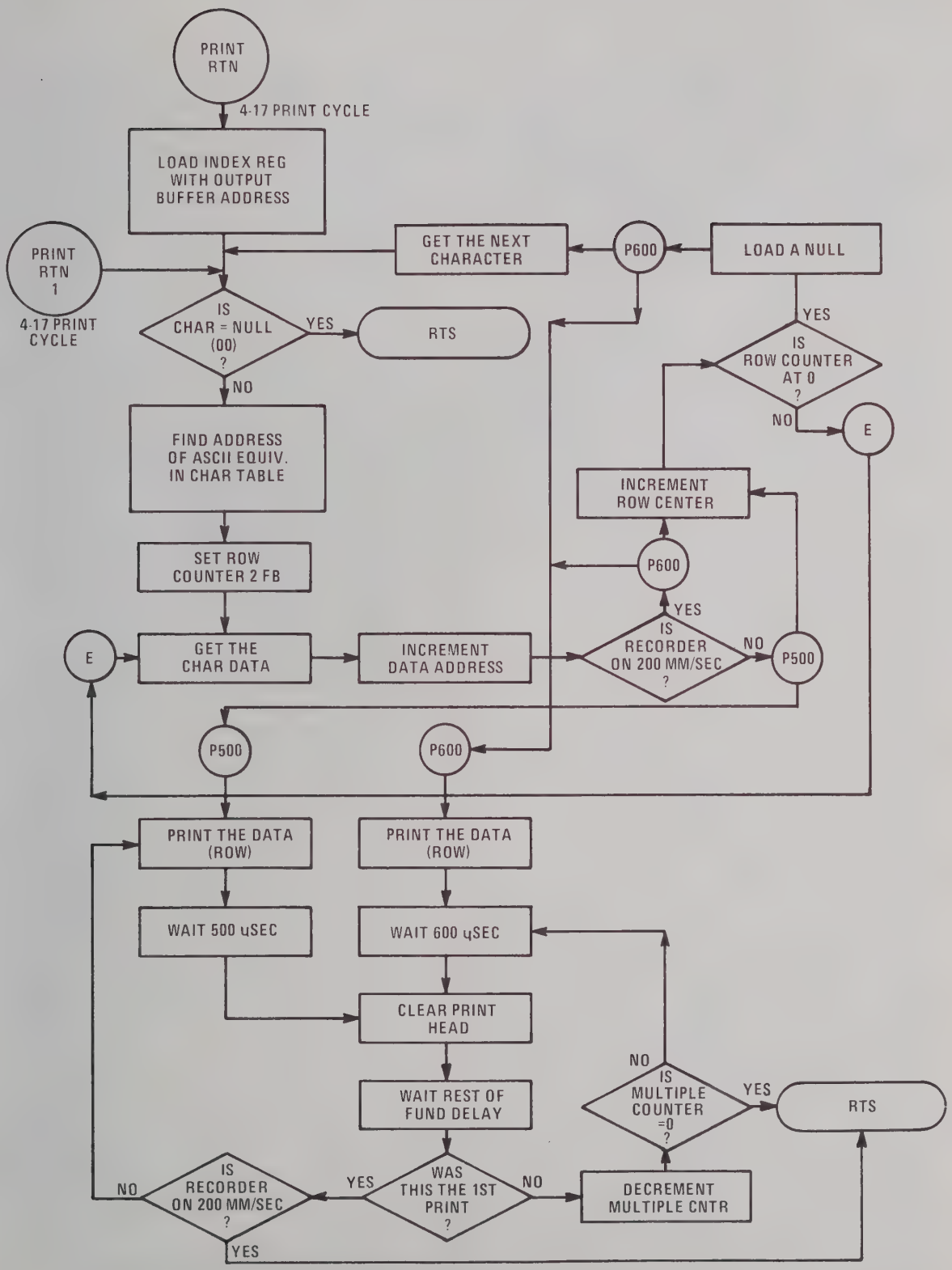
FIGURE 4-18 RS232 INPUT FLOWCHART



bi 2599

FIGURE 4-19 HEX INPUT ROUTINE FLOWCHART



bi 2600

FIGURE 4-20 PRINT TIMING ROUTINE FLOWCHART

tested for a 00 which indicates the print buffer is finished. The character data is then modified to produce an offset to a Look-Up Table which contains the 5 x 7 dot representation of the character. This offset is used to find the address of the character data and stored in memory. A counter called COUNT is used as a counter for the number of rows printed and then the printing loop begins.

The first row of data is stored in memory for double printing purposes. The character data address is incremented and stored, and the delay buffer is then checked to see if the recorder is at 200mm/sec. If it is, the data is sent to the print head, P600, and a 600 μsec timer is started, if not the data is sent to the print head P500 and a 500 μsec timer is started. Upon completion of the delay, the print head is cleared for the remainder of a print cycle which is dependent on the chart speed delays. After completing the first print of the fundamental delay, if the recorder is not running at 200mm/sec, the data stored in memory will be reprinted to increase print quality and the rest of the delay will be completed. Upon completing the required number of fundamental delays, the character row counter is incremented and checked for the fifth row. If it is not there, the next row of data is stored, printed, and the address incremented. If it is finished, the next character in the print buffer is loaded and checked for 00 and the cycle continues as stated above.

4.10.7 Speed Change Routine

This routine is started with a 35 msec delay to allow for the bouncing of the switches or inputs on the bus. This routine is called by the NMI whenever there is a change of speed other than a variable speed change, and updated with every complete print cycle or screen update. This updating allows any changes in variable speed to be picked up. The speed and divide by information are read from port B of the PIA. The speed information is then decoded into the appropriate delays and speed address which are stored in memory. The stored delay is a multiple of the fundamental delay, which is the delay at 200mm/sec, the smallest possible delay. The divide-by information is decoded and used as an offset to the main speed address stored. If the unit is in variable speed, memory will be increased in proportion to the change in chart speed. If the recorder is in stop or ext, the program will return to the beginning of the main program.

4.10.8 Variable Speed Routine

This routine on Figure 4-16, uses the input capture interrupt of the processor. The count on a Free Running Counter is trapped when triggered by the negative going edge of the Step Clock. The subsequent count is also trapped and the first count is subtracted from it. This gives a measurement of the Step Clock period. This sequence is repeated five times and each count is accumulated in a buffer and then divided by five to get an average reading.

This average is then used as a divisor into 12400. This is done to get a proportion of the chart speed in the frequency domain so there will be a linear relationship. This number is then divided by the chart speed, which is read from the PIA, to compute the print speed delay. The actual chart speed is then calculated, formatted in ASCII, and stored. The address the program left from to enter the variable speed routine is recalled at this point to return to where the program was left.

4.10.9 Check User Status (CRT)

This routine can be called by a CU command code, through the RS232 input or 9D command code through the rear panel hex inputs. This will cause the user's settings on the user terminal to be displayed. It will check all user settings by looking at the appropriate flag bits in FLAGS or FLAG1. It will then indicate; 1) annotation being disabled (only if it is disabled), 2) the word "TIME" followed by the time, either real time or IRIG, and whether time is enabled for printing, 3) the word "DATE" followed by the date and its printing status, 4) the word "SPEED" followed by the chart speed selected and its print status, 5) the word "MESSAGE" followed by up to a 50 character user message and its status, and 6) the word "TEST NO." followed by the test number, its print status and a carriage return/line feed.

4.10.10 Enable/Disable Commands

All the enable or disable commands are performed by setting or resetting the appropriate bit in FLAGS or FLAG1. In a couple of this type of command inputs some other initializing may also be done.

4.10.11 Set Time/Data Commands

These two commands are handled essentially in the same manner. First there is a test to check if the

input is RS232 or Hex Switch. If the input is from RS232 the third character is checked for a "S" (Seconds), "M" (Minutes), "H" (Hours) for setting the time or a "D" (Day), "M" (Month), "Y" (Year) for the date. The number is then converted from ASCII to binary, checked if it is within the legal limits of the function being entered, and finally input to the appropriate register in the Real Time Clock ($1000). If there is an error, the error message will be sent to the users terminal.

If the input is from the HEX switches, the command is decoded to the correct address in the routine, the data is then checked if within the legal limits of the function being entered, and the number is then stored in the appropriate register of the Real Time Clock. If there is an error the error light will be turned on.

4.10.12 Direct Data Printing

This routine is used when printing directly to the chart paper is desired. The command "DU" followed by a carriage return enables the routine and it is terminated upon receipt of a carriage return. The routine utilizes a 50 character rolling buffer, a print position indicator and an input position indicator. The routine also uses hand-shaking for controlling data input. A (CONTROL Q) is issued to signal the user device that it is ready to receive data and a (CONTROL S) is issued to stop data transmission indicating that the buffer is full. The timing for data transmission is determined by the chart speed selected (character printing speed) and by the baud rate selected (data input speed).

NOTE: It is not recommended that this feature be used with the handheld pocket terminal or manual data switches.

4.11 STACK TO STACK THEORY OF OPERATION

The 11-2272-00 Kit Assembly adapts a 2000S Thermal Recorder using 15 inch wide roll type paper for "Stack to Stack" operation using Z-fold packs.

Blue-writing and a black-writing thermal paper are available as follows:

Eight 40 mm channels

11-2985-500 (Blue)
11-2985-501 (Black)

Six 50 mm channels

11-2965-500 (Blue)
11-2965-501 (Black)

These papers are also compatible with recorders equipped with Thermal Annotation. Paper is perforated with a 62% cut to allow the paper to gravity fold in the tray without excessive height build-up. The folds are 11.8 inches (30 cm) apart and fall on a major grid line.

4.11.1 General

The kit assembly consists of two major subassemblies and conversion parts.

THE SUPPLY COMPARTMENT mounts directly to the recorder Rack Mount slides and saddle below the recorder. Its functions are to supply paper to the recorder while simulating the roll paper tension and provide a reference location to steer the paper over the paper mandrel. It is supported on brackets hung from the recorder support saddle so that it is always located in the same position relative to the recorder paper mandrel. (Even when the recorder is extended on the slides to get at the calibration controls).

Paper loaded into the supply compartment is random in location since tolerance is required for 0.1 inch of expansion and contraction due to humidity and temperature. The left edge of the paper is chosen as a reference and two forces act on the paper to hug the left side of the supply compartment. One is a differential pressure applied to the felt pad (approximately 8 oz. more on the right than on the left) by the springs on either side pressing on the roller bar. The other force is from the rotation of the helix cut into the roller pressing the paper into the felt pad. As they turn, the thread areas contacting the paper move to the left. Since the rollers are held less than 1/16th inch from the sidewall by a retaining ring, the paper is contained between the roller and the pad and is automatically positioned at the sidewall.

The supply compartment is held to the baseplate with nuts which may be loosened to allow the compartment to be positioned left and right so as cause the left edge of the paper to line up with its roll paper position on the internal mandrel.

The remaining condition required to make the paper track in the same place as with roll paper is to have the paper tension across the writing table the same as the roll paper value (about 2 to 2.5 lbs.) The pad can be renewed (if worn) by slightly springing the compartment sides to replace the pad support channel. The helix on the brake bar is divided into three parts to make the parts short enough to insure that the wall thickness tolerance can be held in manufacturing and increase the reliability in case of warpage.

Two other features are built into the supply subassembly. By attaching the hinged panel door to the tension springs, via the wire loops, the roller tension is automatically removed when loading paper and reapplied when the panel is closed. The lip on the panel, in addition to causing the perforation to "break" at the right place for folding, helps reduce the paper static charge "clinging" effect.

THE TAKE-UP DRAWER is designed to provide for accumulation of a 500 sheet pack without requiring operator attention. It is mounted between slides that detent in the "out" position. A detachable "W" shaped tray is supplied in which paper collects after the first fold is oriented for the original bend direction. The "W" shape compensates for the bend build-up so as to keep the stack relatively flat. The drawer should be fully extended for proper operation. Note that a large finger hole is provided in both the tray and the bottom plate to permit lifting the accumulated paper stack.

A few conversion parts are required in the recorder itself. A small "L" shaped arm, called a "pressure defeat arm" is added to the right sideplate. Its function is to hold the brake pad arm extending through the large slot in the sideplate from moving

to the end of its travel when Z-fold feature is used. This prevents the two white rollers which normally ride on the paper roll from deflecting the Z-fold paper but still allows the microswitch which detects "paper out" to work. An empty paper core (same as standard roll paper core) is supplied to fit the dual flange mandrel. Note that the step on each flange spaces the roll paper away from the flange slightly and excessive tightening can deform the core tube so that the Z-fold paper would bind against the flanges. The mandrel does not rotate when Z-fold paper is used because the brake pad locks the mandrel when the table is closed. The drag of the paper over the core tube is not sufficient to cause the mandrel to rotate. Insertion of the mandrel with the notch in the core tube to the left insures that the left flange is in the same location as for roll paper - which maintains tracking accuracy.

Paper alignment mark is provided on the writing table left edge to assure quick and reliable tracking stabilization. If aligned along the mark, the left event marker should deviate less than 0.5 mm from its at-rest position within 3 to 6 sheets of paper on start-up. Paper should be pulled taut with the hinged supply door panel closed to allow the brake pad to provide tension (before closing the recorder table). Otherwise, the paper may be so slack that the "paper out" interlock may prevent the recorder from running or the paper so misaligned that the edges become torn on the mandrel flanges.

CAUTIONS:

1. **Care must be practiced so pens are not damaged when threading paper through the recorder.**

2. **Observe the label on the table handle -- remove power before opening. Thermal pens have "pre-heat" which keeps them hot during standby. They will burn a hand or a hole in the paper.**

3. **A threading shield has been incorporated in the kit to protect the operator from touching the 220/110 volt conversion board while threading paper up from the supply drawer. This shield must be in place when the stack to stack kit is used.**

SECTION V

MAINTENANCE

5.1 INTRODUCTION

This section contains paragraphs describing operation maintenance, preventative maintenance, calibration, troubleshooting, and subassembly replacement. Operative maintenance generally refers to maintaining materials regularly consumed in operation, i.e., paper and pens. Preventative maintenance consists of cleaning, lubrication, and periodic inspection.

5.2 OPERATIVE MAINTENANCE

5.2.1 Chart Paper Replacement

WARNING: BEFORE ATTEMPTING TO REPLACE CHART PAPER TURN POWER OFF AND DISCONNECT RECORDER FROM POWER SOURCE.

1. Grasp pull bar (Figure 5-1) and open writing table.

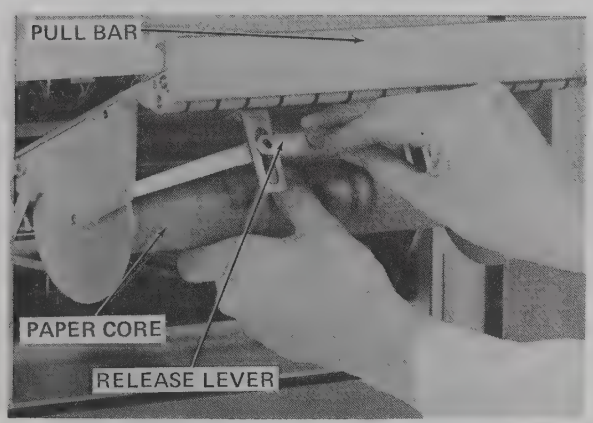


FIGURE 5-1 PAPER ROLL REMOVAL

2. Hold paper supply roll and pull down on paper supply release lever. Remove paper supply roll.

3. Unscrew right flange/shaft from paper supply roll. Remove and discard core (Figure 5-2).

4. Slide left flange into paper roll. Make sure notches in paper core align with guide pins on left flange and paper edge is facing forward and down.

5. Make certain right flange has a shim washer as shown, then screw into left flange until it is snug against paper edge.

6. Insert paper roll into writing table assembly. Push release lever up to lock into position.

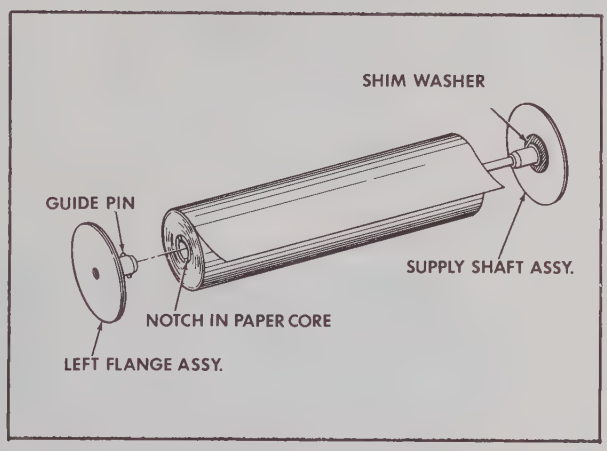


FIGURE 5-2 CHANGING CHART PAPER

CAUTION: MAKE SURE SHAFT IS SEATED PROPERLY AND ROTATES FREELY. USE CARE WHEN THREADING PAPER SO AS NOT TO DAMAGE PENS.

7. Refer to Figure 5-3. Feed paper over writing bar, down through slot between pull bar and drive roll, around pressure roll, and out to front of writing table assembly.

8. Slowly close writing table while gently pulling on chart paper. When friction resists rotation of paper roll, pull paper taut and center, and close writing table assembly. Make sure table is completely closed.

9. Turn recorder on and run out about two feet of chart paper at 100mm/sec to align on writing table.

5.2.2 Ink Cartridge Replacement

The ink supply, dependent on use, should be sufficient for about one year. When ink cartridge replacement becomes necessary, recorder must first be removed from its case in portable models or slid out of cabinet in rack mount models. To slide unit out of cabinet, remove 4 screws from panels along left and right front sides of recorder. Recorder will slide out of cabinet.

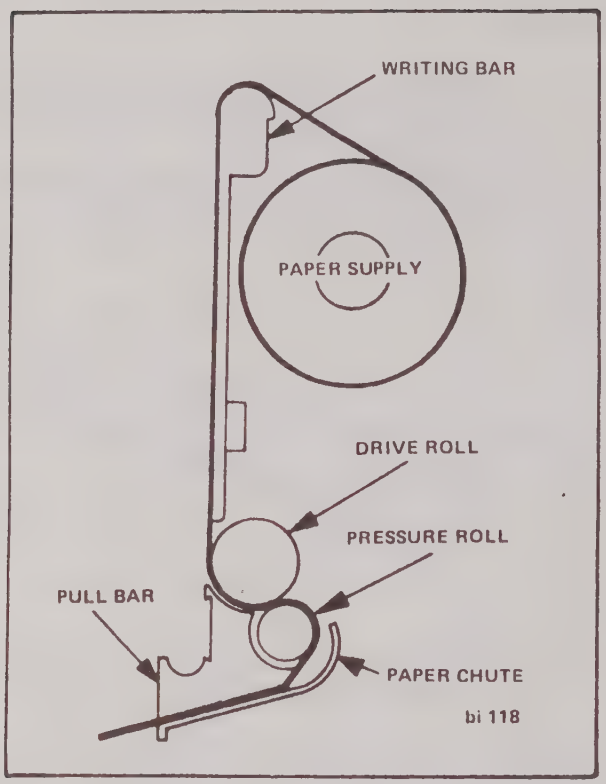


FIGURE 5-3 PAPER THREADING DIAGRAM

Some instructions may not apply to your model.

To remove recorder from case (portable models) and change the ink cartridge use the procedure that follows:

CAUTION: EXERCISE CARE WHEN REMOVING RECORDER FROM CASE SO AS NOT TO DAMAGE PRINTED CIRCUIT BOARDS

1. Remove preamplifiers or get assistance to support weight of preamp cage (flip-top only).
2. Position the case on its left side and remove the 6 screws which hold recorder from the bottom. Return case to the upright position. Remove 4 front panel screws.
3. Open side access door and unplug the preamp cage connectors and pull them slightly so that they hang outside of the case. (flip-top only)
4. Remove the 2 forward thumb screws (1 on each side of case) and carefully lift up the front of the preamp cage to the full open position. (flip-top only)

WARNING: DO NOT ALLOW THE PREAMP CAGE TO FALL ONTO HANDS OR ARMS.

5. Remove the 2 screws at the top of the recorder that have just been exposed. (flip-top only)
6. Slide recorder out from front of case. Do not allow the case to fall backwards as the heavy recorder is removed from it. Do not pull from top of recorder or chart take-up.
7. Ink cartridge is attached to ink plunger assembly. (See Figure 5-4 or 5-4A.)
8. Observe large hole or slot. Activating screw is located under hole. Turn screw clockwise until spring in ink plunger is drawn up tight.
9. Turn ink off at solenoid valve and slide bar on manifold. Follow direction of arrows.
10. Remove hardware holding ink plunger assembly to bracket. (See Figure 5-4 or 5-4A.) Carefully pull ink plunger assembly (with ink cartridge) straight up and out of recorder. Retain hardware.
11. Place paper towel under ink tubing where it is connected to bottom of ink cartridge. Carefully pull ink tubing off ink cartridge.

CAUTION: DO NOT USE TOOLS WHICH COULD GOUGE OR CUT THE INK TUBING.

12. Unscrew ink cartridge from plunger assembly and discard (Figure 5-5).
13. Remove piston retainer from replacement cartridge and discard (Figure 5-5).
14. Screw new ink cartridge onto ink plunger assembly and tighten firmly.
15. Remove shipping cap from ink cartridge and discard (Figure 5-5).
16. Install ink tube on ink cartridge.
17. Attach ink plunger assembly (with ink cartridge) to top bracket assembly with exiting hardware.
18. Turn activating screw counterclockwise until snug to pressurize ink systems. Turn ink on at solenoid valve and slide valve on manifold following directions of arrows. Check system for leaks.
19. Install recorder back into case or cabinet in reverse order of disassembly.

WARNING: THE INK PLUNGER ASSEMBLY CONTAINS A COMPRESSED SPRING WHICH COULD BE HAZARDOUS. DO NOT TAKE APART. USE CAUTION WHEN HANDLING.

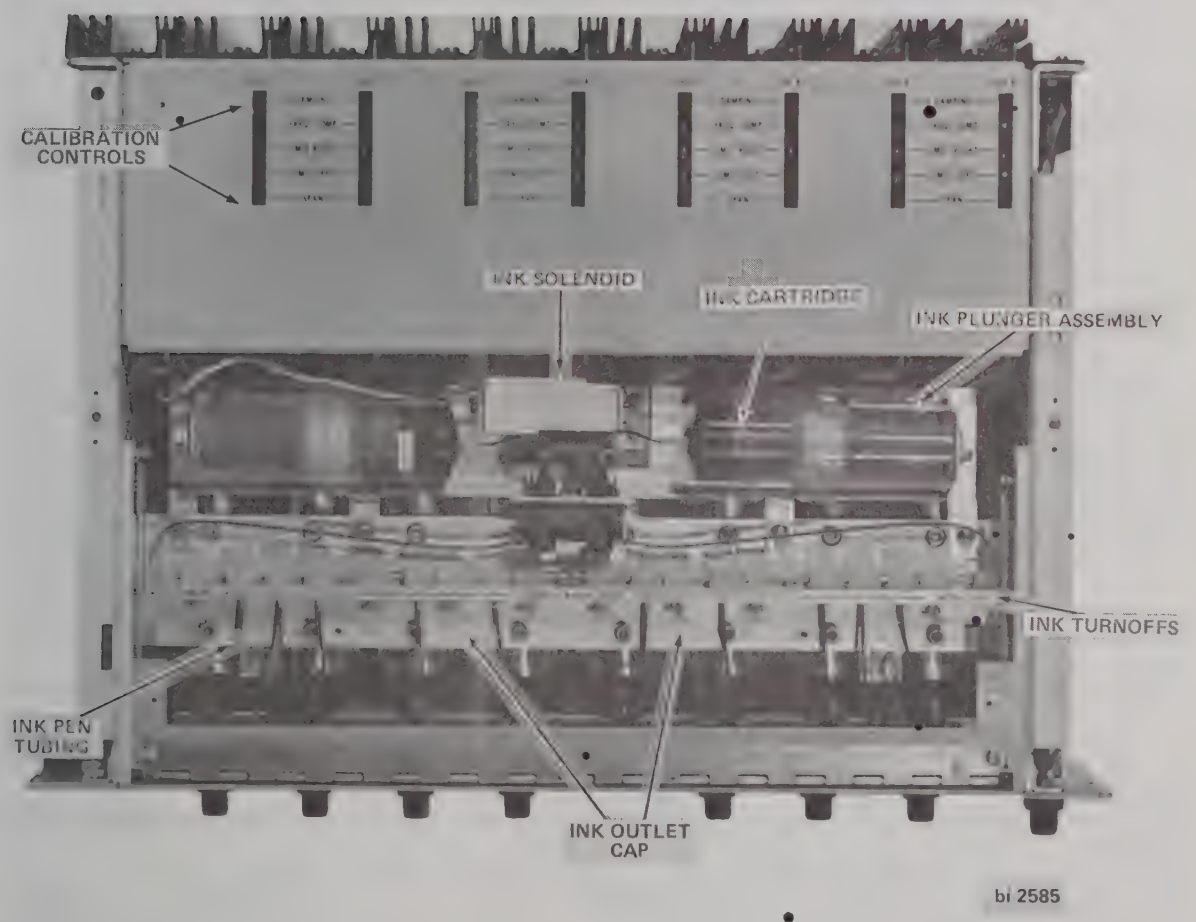


FIGURE 5-4 RECORDER, TOP VIEW
(2800S VERSION SHOWN)

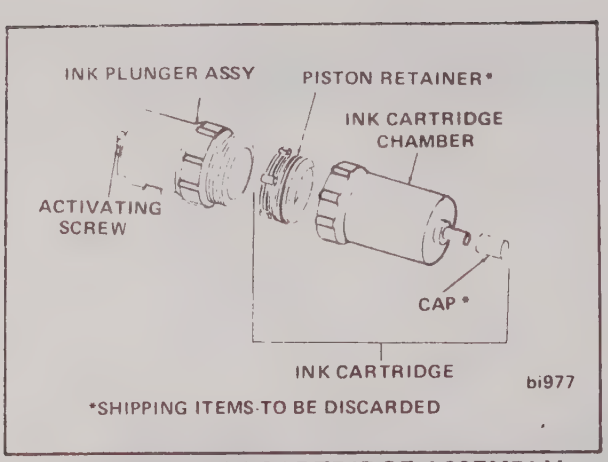


FIGURE 5-5 INK CARTRIDGE ASSEMBLY

5.2.3 Pen Replacement

Pens should only be replaced when excessively worn or broken. Replacement should be performed only by personnel who are familiar with the recorder. Replace and adjust one pen at a time.

CAUTION: POWER MUST BE OFF.

a. Analog Pen

NOTE: **See Section 1 for Analog Pen part number.**

1. Remove top front cover from recorder (slide cover forward and lift out). This gains access to individual manual valves.
2. Slide ink valve of pen to be changed to "OFF" position. Follow direction of arrows on manifold bar (See Figure 5-4 or 5-4A)

CAUTION: DO NOT PERMIT INK TO SPILL ON RECORDER COMPONENTS. PLACE PAPER TOWELS AROUND AREA.

3. Carefully remove ink tube from manifold valve nipple. Wipe excess ink from nipple.
4. Raise pen access cover by pulling out on bottom and sliding back into recorder.
5. Raise front of cover with one hand and carefully remove ink tube from pen with other hand. Discard ink tube.
6. Loosen two screws (do not remove) which secure pen to drive arm and carefully slide pen off in downward motion (Figure 5-6).

NOTE: If pen does not readily slide off, it may be necessary to loosen pen pressure adjustment screw also.

7. Carefully slide new pen onto drive arm. Snug the two screws to secure pen. (Pen should be perpendicular to writing surface.)
8. Install new ink tubing between valve nipple and pen.
9. Slide ink valve to "ON" position. Follow direction of arrows on manifold bar.
10. Turn recorder ON and run at a chart speed of 5 mm/sec.
11. Carefully lift pen slightly and allow ink to bleed through pen tip.
12. Shut down recorder.
13. Gently grasp pen near top and move it across entire channel. If trace is not parallel to a horizontal line and/or pen is not on same line as other pens, turn pen in screw slots and slide pen vertically. Tighten screws.
14. Lap pen per paragraph 5.3.4 if necessary.
15. Measure pen pressure per paragraph 5.3.3.

b. Event Marker Pen

NOTES:

1. **Use steps 1 thru 5 from paragraph 5.2.3a, Analog Pen, for changing Event Marker Pen.**
2. **See Section 1 for Event Marker Pen part number.**

1. Loosen two screws (do not remove) which secure pen to bracket assembly and carefully slide pen off in downward motion (Figure 5-6).

NOTE: If pen does not readily slide off, it may be necessary to loosen pen pressure adjustment screw also.

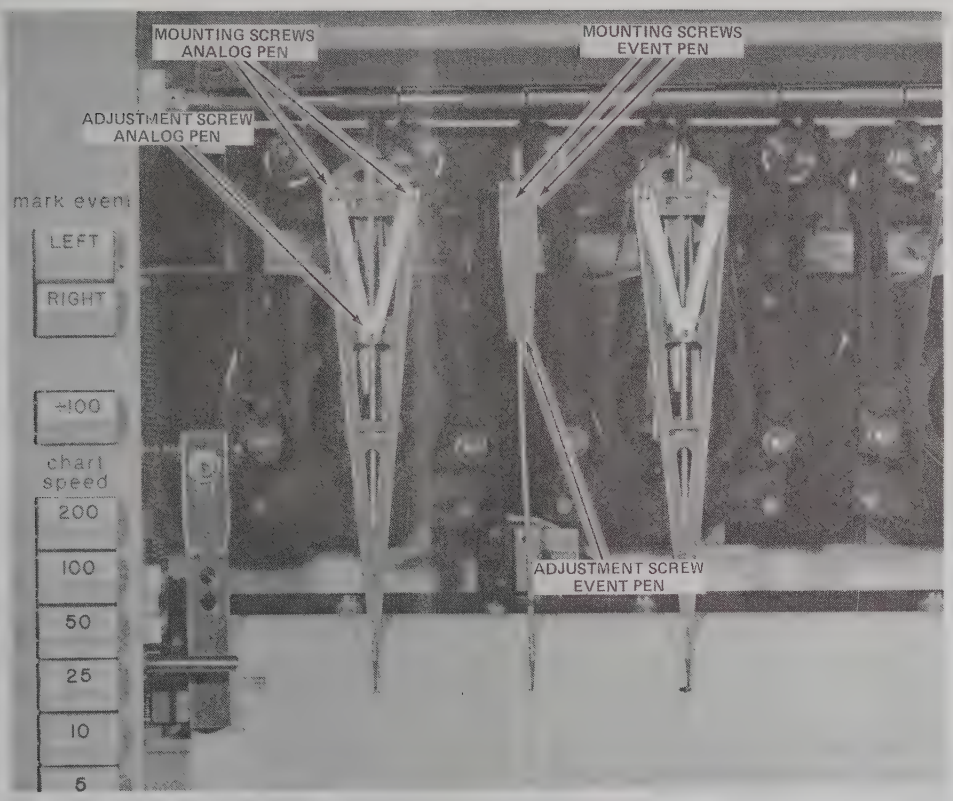


FIGURE 5-6 PEN REPLACEMENT

2. Carefully slide new pen between pen pressure bracket and bracket assembly. Snug the two screws to secure pen. (Pen should be perpendicular to writing surface.)

3. Install new ink tubing between valve nipple and pen.

4. Slide ink valve to "ON" position.

5. Turn recorder ON and run at a chart speed of 5 mm/sec. Adjust pen ZERO to set pen on event gridline.

6. Carefully lift pen slightly and allow ink to bleed through pen tip.

7. Shut down recorder.

8. If pen tip is not on same line as other pens, loosen screws and slide pen vertically, Tighten screws.

9. Lap pen per paragraph 5.3.4 if necessary.

10. Measure pen pressure per paragraph 5.3.3.

5.2.4 Fuse Replacement

WARNING: BEFORE ATTEMPTING TO REPLACE FUSES TURN POWER OFF AND DISCONNECT RECORDER FROM POWER SOURCE.

All fuses are located on the Control/Timer Board Assembly. The board is a plug-in module accessible from the rear panel. (See Figure 5-7.) The Control Board is easily distinguished from the other boards because a timer switch is mounted on its heat sink. Remove the top and bottom screws which secure the board to the recorder and remove the board by grasping the heat sink and pulling it out and away from the recorder. All fuses are located near the top of the Control Board. Table 6-1, which follows, defines usage of all fuses.

*Frequency for all models is 50/400 Hz.

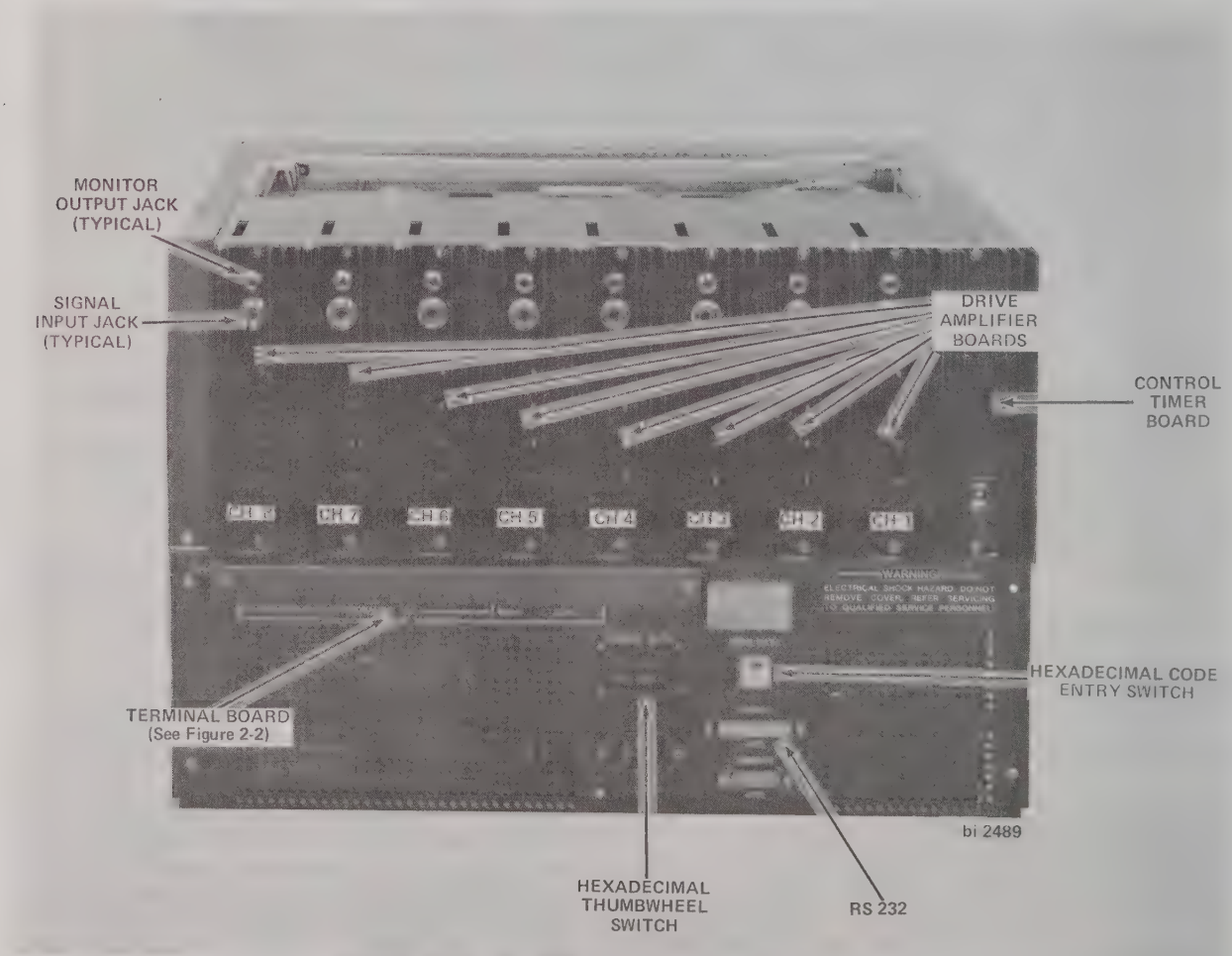


FIGURE 5-7 RECORDER, REAR VIEW (2800 VERSION SHOWN)

5.2.5 Thermal Annotation Head Adjustment

Recorders with Thermal Annotation have fixed, factory-set HEAD tension. Measured force required to lift thermal head off paper should be 180 ±20 grams. No adjustments can or should be made to the overall force.

a. Dot Density Variation

Slight density differences between the top and bottom dots of the printed characters can be corrected by adjusting the (2) small screws located on the annotation head mounting arm. These screws are on opposite sides of a pivot so it is advantageous to first loosen the screw on the half of the character which is darker, then tighten the opposite screw the same amount as the first was loosened.

b. Annotation Arm Horizontal Position

1. Select 10mm/sec and adjust the annotation arm position, by moving the grip ring, so the distance on the chart between the left chart edge of channel 1 and the rightmost dot of the annotation character is:

   .150" for 8 channel ink and thermal recorders
   .450" for 6 channel ink recorders
   .410" for 6 channel thermal recorder
   .190" for 2 and 4 channel ink and thermal recorder

2. Enter 90 on the Manual Data switch (from Table 3-2) to enable annotation, push the Send Data switch and observe annotation is legible.

c. Annotation Arm Vertical Position (Time Line Adjustment)

1. With the chart stopped, the lateral traces of all pens including event markers should mark on the same major lateral time line that the annotation head prints the arrow (⟝) when monitoring an event time occurrence.
2. To check this alignment, press the Stop button and make lateral traces of pen tips on a major lateral time line.
3. Enter 89 on the Manual Data switch (from Table 3-2), press Send Data switch. Enter 90 on Manual Data switch, press Send Data switch.
4. Press 5mm/sec., allow the chart to move approximately 15mm and then stop the chart.
5. Observe the arrow (⟝) alignment relative to the lateral traces on the chart. Make adjustments to arm as necessary, repeating steps 2 and 4 to verity alignment.

5.3 PREVENTIVE MAINTENANCE

5.3.1 Recorder Cleaning

a. General Cleaning

CAUTION: AVOID USE OF CHEMICAL CLEANING AGENTS WHICH MIGHT DAMAGE PLASTIC OR PAINTED SURFACES. DO NOT USE CHEMICALS WHICH CONTAIN TOLUENE, ACETONE, OR SIMILAR SOLVENTS.

EXTERIOR: Remove loose dust with a soft cloth or small paint brush. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Do not use abrasive cleaners.

INTERIOR: Dust in recorder interior should be removed occasionally due to its electrical conductivity under high-humidity conditions. Blow off accumulated dust with dry, low-pressure air. Remove any dirt which remains with a soft paint brush or a soft cloth dampened in a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces and/or printed circuit boards.

b. Ink Removal

NOTE: The recommended ink remover is ANCHOR HAND CREAM, No. 25 obtainable from Anchor Office Supply Company of Cleveland, Ohio.

1. Blot up any excess ink with a tissue or paper towel.
2. Apply ink remover to the inked area ONLY. DO NOT attempt a general cleaning.
3. Gently rub the area with a soft cloth until the ink spot is removed.
4. Wipe the area thoroughly with a damp cloth.
5. Allow cleaned area to dry at least ten minutes before using recorder.

5.3.2 Pen Cleaning

Intermittent, missing, or faint traces may be indications of a clogged pen. The following cleaning procedure is intended as a guide, but may not always prove effective. Access to individual manual valves is required.

1. Turn recorder OFF.
2. Slide ink valve of pen to be cleaned to "OFF" position. Follow arrows.
3. Remove ink tubing from manifold valve nipple.
4. Remove pen (Paragraph 5.2.3a or 5.2.3b).

5. Modify No. 18 hypodermic needle per Figure 5-8.

6. Attach modified needle onto 2 cc hypodermic syringe.

7. With syringe plunger depressed, insert needle in pen tubing.

8. Immerse pen tip in cleaning agent (Isopropyl Alcohol, Cell-O-Solve or equivalent).

9. Backflush by slowly withdrawing syringe plunger.

NOTE: It may be necessary to allow the pen to remain for a brief period in the cleaning agent to dissolve dried ink at pen tip.

10. Install pen (para. 5.2.3a or 5.2.3b).

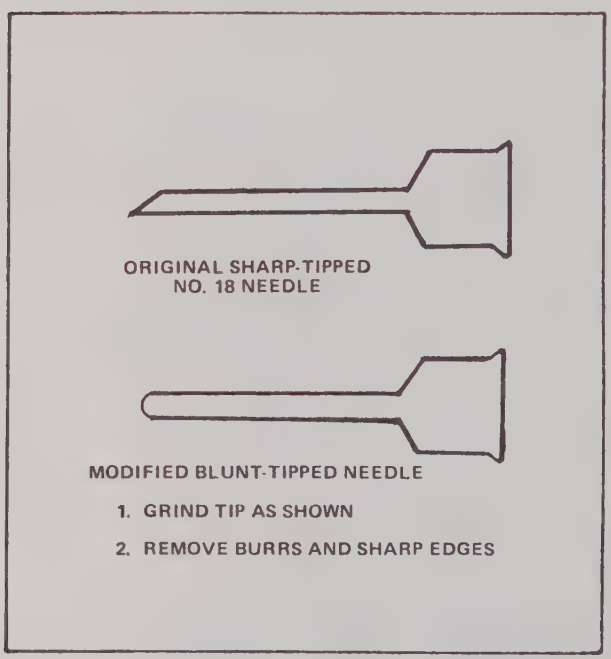


FIGURE 5-8 HYPODERMIC NEEDLE MODIFICATION

5.3.3 Pen Pressure Measurement

Analog or event marker pen pressure should be checked after replacement, if the ink trace is excessively wide (bleeding), indicating low pen pressure or if pen gouges the chart paper, indicating excessive pen pressure.

NOTE: Wide trace may also indicate an improperly lapped pen. Refer to Paragraph 5.3.4 for pen lapping procedures.

The gram gage (part number 240601-910) is used to measure the pressure of the analog and event marker pens as follows:

1. Raise pen access cover by pulling out on bottom and sliding back into recorder.

2. Turn ON recorder and set chart SPEED at 5 mm/sec.

3. Place gram gage hook under pen as close as possible to top. From a right angle to pen shaft with hook (Figure 5-9).

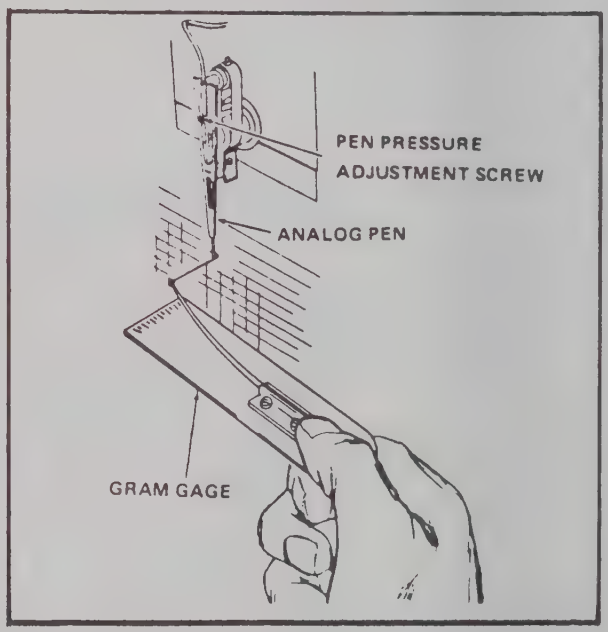


FIGURE 5-9 PEN PRESSURE MEASUREMENT

4. Pull pen from chart as shown in Figure 5-9 and take reading on gage the moment excessive ink starts to flow from pen.

5. Proper pressure for analog pens is 30 ±2 grams, for event marker pen 25 ±2 grams.

6. If pen pressure is not within specified limits, adjust pressure using special pen adjustment wrench (Gould part number 1-120922-18). Refer to Figure 5-10. Turn screw clockwise to increase pressure, counterclockwise to decrease pressure.

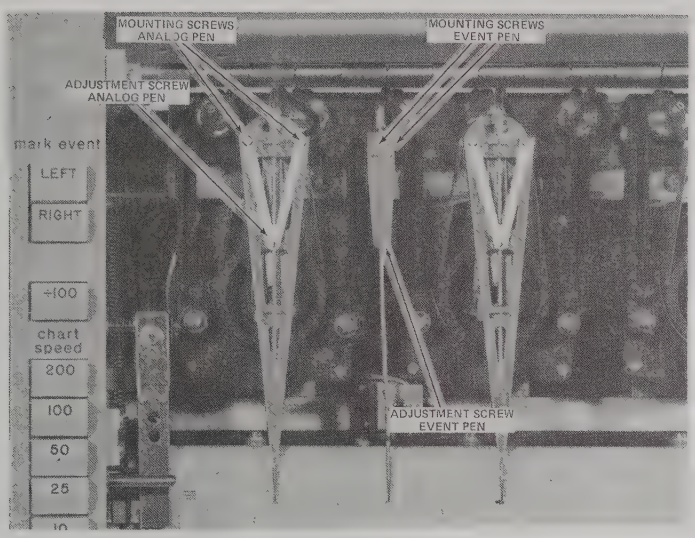


FIGURE 5-10 PEN PRESSURE ADJUSTMENT

7. Recheck pen pressure per steps 3, 4 and 5.

5.3.4 Pen Lapping

a. General

This paragraph describes and illustrates the proper procedures for lapping the analog and event pens. Intermittent or "wet" ink trace are indications that pen pressure is incorrect or that pen requires lapping. Check for "wet" writing by operating the recorder (no signal applied). Check pen trace by wiping index finger, with moderate pressure, across trace approximately one inch below pen tip. If ink does not smear, pen is properly lapped. If trace smears, check and adjust pen pressure (paragraph 5.3.3). Repeat test, and if trace continues to smear, lapping is required.

b. Lapping Procedures

CAUTION: LAPPING SHOULD ONLY BE DONE WHEN ABSOLUTELY NECESSARY. EXCESSIVE LAPPING WILL SHORTEN PEN LIFE.

1. Turn OFF recorder.

2. Raise pen access cover by pulling out on bottom and sliding it back into recorder.

3. Carefully raise pen tip just enough to slide a small strip of lapping paper (Gould part number 669234, Silicon Carbide, M-600 grit) under pen tip.

4. Refer to Figure 5-11. Hold lapping paper flat against writing table and move it in a circular motion several times while gently pressing pen tip with finger.

5. Remove lapping paper and clean debris from pen tip. Operate recorder at 5 mm/sec chart SPEED.

6. Check pen trace by wiping index finger, with moderate pressure, across trace about one inch below pen tip. If ink does not smear, pen is properly lapped. If ink smears, check pen pressure per paragraph 5.3.3.

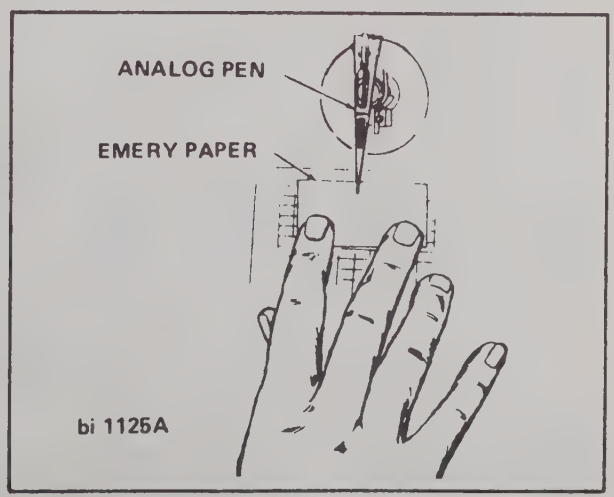


FIGURE 5-11 PEN LAPPING

5.3.5 Manifold Bleeding Procedure

a. **General**

After changing or replacing the manifold assembly, it is imperative that the inking system is bled before operating the recorder. This is necessary so that any air trapped in the system is removed to guarantee uninterrupted writing. It may be desirous to bleed the system when changing ink cartridges also. SEE WARNING ON FIGURE 5-4.

b. **Bleeding Procedure**

1. Close all ink valves including those mounted on manifold (20) and both main valves which are part of valve and solenoid assembly (see Figure 5-12).

2. Remove all pen tubing from manifold nipples (18) and cover nipples with ink outlet caps (*P/N 249360).

3. Place inking system under pressure by turning activating screws on ink plunger assemblies counterclockwise until ink fills tubing linking ink cartridges with main valves.

4. Open both main valves (part of valve and solenoid assembly). Push hinged main valve assemblies closed toward rear of recorder). Solenoid plunger will close, opening diaphragms in valve assemblies. Hold closed. Ink should fill tubing linking main valves and 2 end manual valves.

5. Open 2 end manual valves by sliding them in the directions of the arrows on the manifold bar to the "ON" position. Both manifolds should fill with ink.

6. Place paper towels under capped manifold nipples at this point.

7. Remove ink outlet caps from 2 nipples in the middle of the manifold bar. (These 2 nipple valves are the farthest from the 2 points where ink is supplied to the manifold).

8. Allow a few drops of ink to drip from each nipple by sliding the valves directly behind them in the direction of the arrow to "INK ON".

9. Turn the ink off by sliding the valves in the direction of the arrow to "INK OFF". Wipe the nipples free of excess ink and replace the ink outlet caps.

10. Repeat steps 7 thru 9 for next closest set of nipples to manifold ink sources and so on until all 9 sets of nipples are bled.

11. Replace ink outlet caps with pen tubing where removed in step 2.

*Ordered separately from manifold assembly. 18 required.

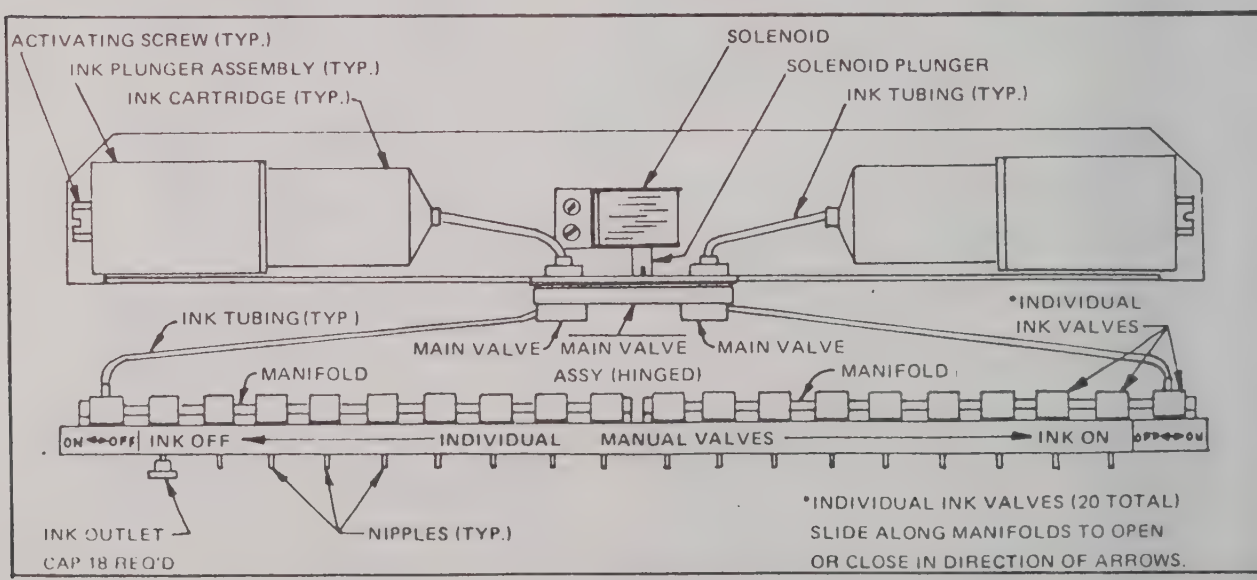


FIGURE 5-12 BLEEDING THE INKING SYSTEM

5.3.6 Case Removal

When removing the case, be careful not to damage gears or switchboard on recorder assembly.

1. Remove 6 large machine screws from bottom of case.

2. Open access door on right side of panel and unplug the (2) 36 pin connectors (J104 & J103).

3. Remove the (4) mounting screws on front of recorder.

4. Slide recorder out from FRONT of case. Push from rear and/or pull from side plates. Do not pull from top front of recorder or chart take-up.

5.4 CALIBRATION

5.4.1 General

The Gould 2XXXS Series Recorder has been factory calibrated. Under normal conditions, calibration will not be required. However, calibration may be required when parts are replaced. This section describes the procedures necessary to calibrate the 2XXXS Series Recorder. Calibration should only be performed by qualified individuals.

5.4.2 Test Equipment Required

Proper test equipment is essential. Use the equipment specified below or its equal.

a. Voltmeter - Triplet Model 630 APL or equivalent.

b. D.C. Calibration Source - Digitek Model 3110 or equivalent.

c. Function Generator - Wavetek Model 164 or equivalent.

d. DVM - Data Precision Model 3500 or equivalent.

e. Oscilloscope - Gould OS 245 or equivalent.

5.4.3 Preliminary Set-Up

a. If the recorder contains preamplifiers, remove each preamplifier from its cage prior to calibrating the channel.

b. Depress recorder STOP button.

c. Plug AC line cord into the proper AC voltage source.

d. Turn ON the recorder.

5.4.4 Pen Drive Amplifiers Calibration Procedure

Calibration is required on pen drive amplifiers (one per channel) and preamplifiers (if recorder is so equipped). Only pen drive amplifier and stepper drive calibration is discussed in this manual. Refer to the applicable preamplifier manual for its calibration.

Calibration controls and procedures are identical for all channels. Refer to Figure 5-13 and calibrate each pen drive amplifier as follows:

5.4.5 Span Adjustment

1. Remove the Recorder top rear cover to gain access. Slide cover back and lift out.

2. Connect a D.C. calibration source thru the large telephone jack, J-201 to amp input. Run the chart at 5mm/sec. Set the input to zero. Using the pen position on the front panel set the pen on the channel zero line on the chart.

3. Apply a +2.5 ±.25 mV signal to the input to deflect the pen to the left. Adjust the SPAN control, R260 for a 50% ±0.1% of full scale channel width deflection.

5.4.6 Limit Adjustment

1. Set the input to zero and turn the pen position fully counterclockwise. Adjust the LEFT LIMIT R208, for 1.5 ±.25 mm deflection beyond the left channel margin.

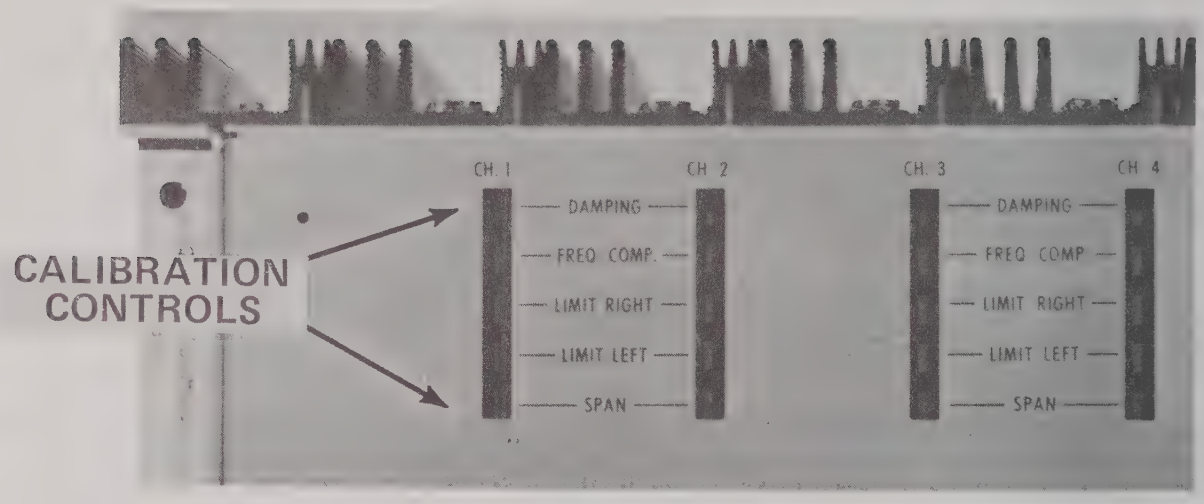


FIGURE 5-13 TYPICAL CALIBRATION CONTROLS

2. Turn the pen position fully clockwise and adjust the RIGHT LIMIT, R205, in a similar manner. Center the pen on chart.

5.4.7 Damping Adjustment

1. Connect a function generator to the input and apply a 4 volt peak-to-peak square wave with a 1 Hz repetition rate.

2. Turn the damping control, R231, clockwise to obtain an overshoot on the pen trace, then turn it counter-clockwise to reduce the overshoot to zero. Check the overshoot at 20 and 100% pen deflection. There should be zero overshoot in either case; readjust if necessary.

5.4.8 Frequency Compensation Adjustment

1. Set the function generator for a 5 Hz sine wave and the chart speed at 25 mm/sec. Adjust the input amplitude to obtain a 40 mm pen deflection on the chart.

2. Step change the input frequency from 5 to 50 Hz. Adjust the FREG. COMP., R209 so that the 50 Hz amplitude is within .1 mm of the 5 Hz amplitude.

5.4.9 Mainframe Tests

Chart Speed Accuracy - 90% of Line Voltage

1. Set variable speed control to detent. Connect a one second, line synchronous, time base generator to the left event marker terminals on TB101-6 and 7. Run the chart at 100 mm/sec at low line voltage, for at least 20 seconds. Measure the distance between the second and the 11th timer mark. It should be 1000 ±2.5mm. Insure that all chart speed buttons function.

2. With variable speed control set to detent, run chart at 25 mm/sec. Set variable speed control to full CCW position and verify that chart speed is less than 10 mm/sec. Return to detent.

5.4.10 Remote Control

1. Set chart to stop. Remove the remote link on TB101-3 and -4. Install a SPST switch, run the recorder at 5 mm/sec. Operate the remote link switch. The chart should start and stop depending on the switch position. Stop chart and replace the remote link.

2. Plug PT-83021 into the remote connector J102. Put remote enable switch in 'local' position. Put 'stop' switch in 'go' position. Select a speed of .05 mm/sec. On switches S1 thru S4 of PT-83021 select the chart speed code for .05 mm/sec (see Table 3-5).

3. Put remote enable switch to 'remote'. Verify no change in operation.

4. Leaving remote enable in remote, select another speed on the recorder front panel. Verify no change in operation.

5. Repeat steps 1 thru 4 for the other speeds.

6. With remote enable in remote position and the code for 5 mm/sec on S1-S4, operate 'stop' switch. Verify that chart stops.

7. Repeat 3-6 with remote enable in 'local' position, and a speed of 5 mm/sec selected on front panel.

8. With enable in 'local' position, connect a TTL compatible pulse train to J102 pin 9. Select 'ext' on the front panel. Verify that the chart moves proportionally with the frequency of the pulse train up to 20 KHz. Start at 10 KHz and gradually accelerate to 20 KHz. 20 KHz will give a chart speed of approximately 250 mm/sec.

5.4.11 Standard Event Markers

1. Run the recorder at 5 mm/sec and alternately short and unshort TB101-6 and -7. The left event marker should deflect to the left when the terminals are shorted. Repeat for the right event marker shorting TB101-9 and -10.

2. Apply a +2.4 ±.1 VDC signal to TB101-6 and -5. The left event marker should operate. Use TB101-9 and -8 to operate the right event marker. TB101-6 and -9 are common GND.

3. Push the chart drive stop and repeat the above tests. The event markers should not operate when the recorder is in the stop mode.

5.4.12 Optional Event Markers

1. Run the recorder at 5 mm/sec and alternately short and unshort terminals TB101-11 and -12. The first optional marker should operate. Optional event markers use pairs of terminals where the odd terminal is grounded. The second optional event marker is connected to TB101-13 and-14. Check out all event markers.

2. With the recorder in the stop mode, optional event markers should not operate.

5.4.13 2XXXS Chart Drive Processor Board Assembly (896073) Calibration

The purpose of this calibration procedure is to synchronize the selected speeds with the chart speed.

1. Set R23 (Processor Board) to mid-range and the variable speed control full clockwise to detent (refer to Figure 5-14).

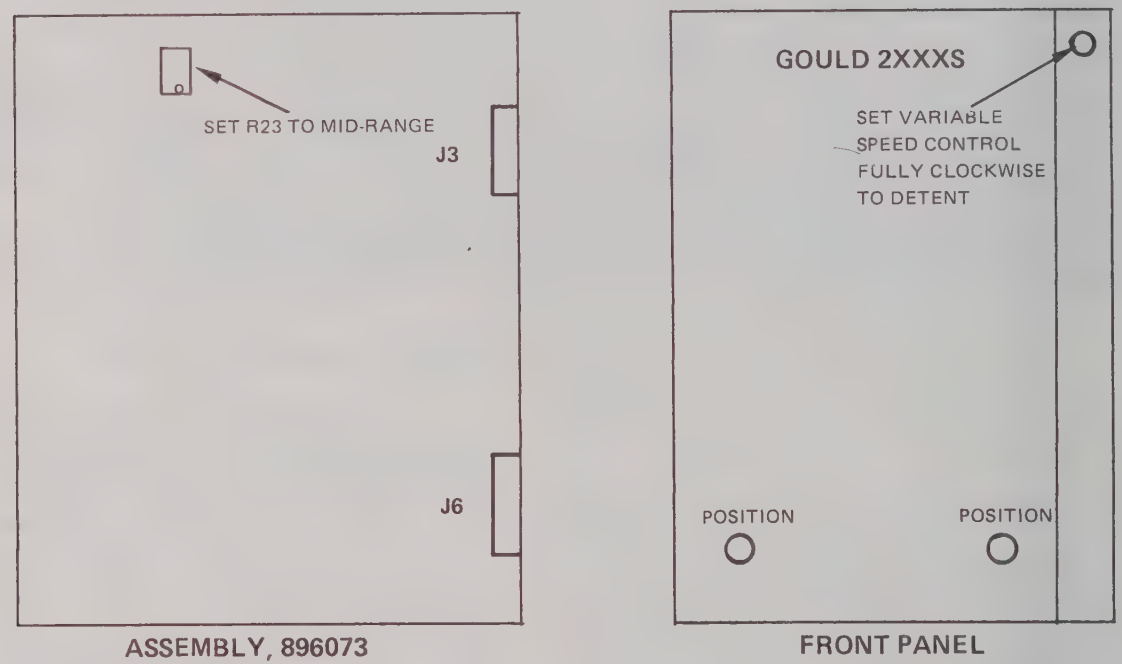


FIGURE 5-14 PROCESSOR BOARD CALIBRATION

2. Set DIP Switch SW1 to Hexadecimal 80 (see Figure 5-15 and Figure 5-16). SW1 is the 8 position DIP Switch.
3. Monitor TP1 with an oscilloscope. Use pin 6 of J6 as common.
4. Adjust R23 to obtain a stable 0V ±500 mV at TP1. TP1 may be "hunting", i.e., either a positive going or negative going ramp. The correct adjustment of R23 will eliminate this.
5. Connect a 1 second timer to the right event marker.
6. Select a chart speed of 25 mm/sec and run out 1 meter of chart paper. Measure event tics with meter stick. This distance between 41 consecutive tics should be 1 meter ±2.5 mm.
7. If the distance in step 6 was too great, the chart is fast. Increment the number on SW1 (see Figure 5-16).
8. If the distance measured in step 6 was too small, decrement the number on SW1 (see Figure 5-16).
9. Select any speed, and then select stop.
10. Repeat steps 6 thru 9 until the distance measured is 1 meter ±2.5 mm.
11. Adjust R23 for 0V ±100 mV at TP1 using a DVM with chart running at 25 mm/sec.
12. Check speed at 100, 50, 10, and 5 mm/sec using the event timer and meter stick.

NOTE: Whenever SW1 is changed to a new value, make sure you depress the stop button before proceeding with calibration. Depressing the stop button allows the processor to read the new speed.

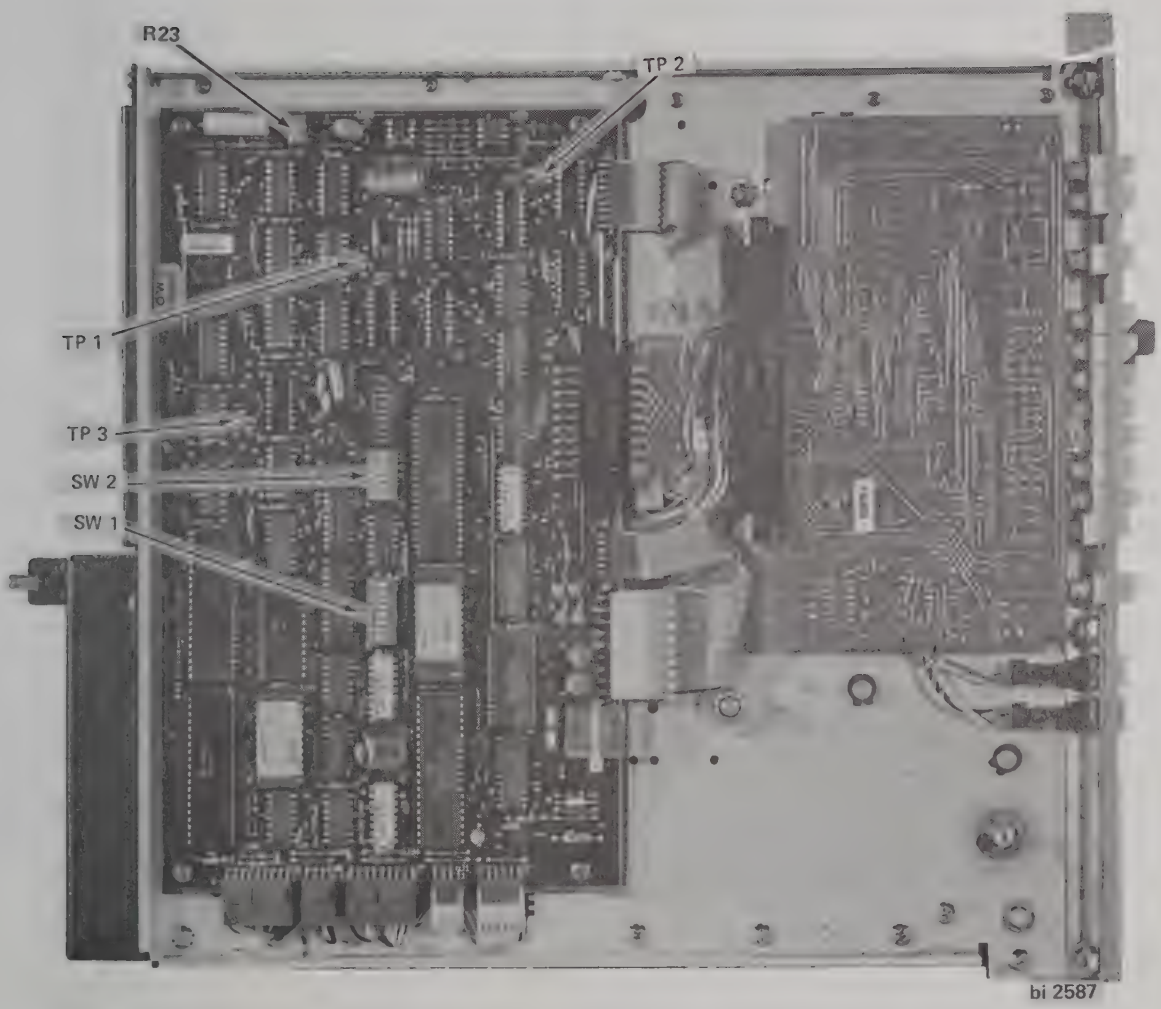
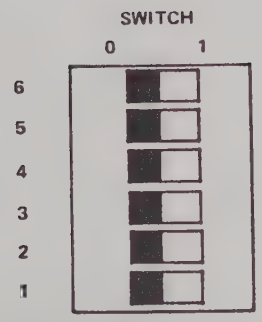


FIGURE 5-15 PROCESSOR BOARD CALIBRATION

	INCREASE									DECREASE							
Hex No.	1	2	3	4	5	6	7	8	Hex No.	1	2	3	4	5	6	7	8
80	On	On	On	On	On	On	On	Off	80	On	On	On	On	On	On	On	Off
81	Off	On	On	On	On	On	On	Off	7F	Off	Off	Off	Off	Off	Off	Off	On
82	On	Off	On	On	On	On	On	Off	7E	On	Off	Off	Off	Off	Off	Off	On
83	Off	Off	On	On	On	On	On	Off	7D	Off	On	Off	Off	Off	Off	Off	On
84	On	On	Off	On	On	On	On	Off	7C	On	On	Off	Off	Off	Off	Off	On
85	Off	On	Off	On	On	On	On	Off	7B	Off	Off	On	Off	Off	Off	Off	On
86	On	Off	Off	On	On	On	On	Off	7A	On	Off	On	Off	Off	Off	Off	On
87	Off	Off	Off	On	On	On	On	Off	79	Off	On	On	Off	Off	Off	Off	On
88	On	On	On	Off	On	On	On	Off	78	On	On	On	Off	Off	Off	Off	On
89	Off	On	On	Off	On	On	On	Off	77	Off	Off	Off	On	Off	Off	Off	On
8A	On	Off	On	Off	On	On	On	Off	76	On	Off	Off	On	Off	Off	Off	On
8B	Off	Off	On	Off	On	On	On	Off	75	Off	On	Off	On	Off	Off	Off	On
8C	On	On	Off	Off	On	On	On	Off	74	On	On	Off	On	Off	Off	Off	On
8D	Off	On	Off	Off	On	On	On	Off	73	Off	Off	On	On	Off	Off	Off	On
8E	On	Off	Off	Off	On	On	On	Off	72	On	Off	On	On	Off	Off	Off	On
8F	Off	Off	Off	Off	On	On	On	Off	71	Off	On	On	On	Off	Off	Off	On
90	On	On	On	On	Off	On	On	Off	70	On	On	On	On	Off	Off	Off	On
91	Off	On	On	On	Off	On	On	Off	6F	Off	Off	Off	Off	On	Off	Off	On

1 COUNT = .125 MM/1000 MM

SPEED ADJUST DIP SWITCH SETTINGS (SW1)
FIGURE 5-16



NOTE: ALL SWITCHES SHOWN IN O POSITION
(SWITCH LEVER SHOWN IN BLACK)

BAUD RATE SELECT

Switch 6 5 4	Frequency (Hz)	Baud Rate
0 0 0	2,400	300
0 0 1	4,800	600
0 1 0	9,600	1,200
0 1 1	19,200	2,400
1 0 0	76,800	9,600
1 0 1	115,200	14,400
1 1 0	153,600	19,200

DIVIDE-BY SELECT

Switch 3 2	Divisor
0 0	/100
0 1	/60
1 0	/1000

NOTE: UNIT INOPERATIVE IF SWITCHES 3 & 2 ARE BOTH 1'S

INTERNAL CONTROL SWITCH SETTINGS OF SW2 FOR BAUD RATE AND DIVIDE-BY SELECT
FIGURE 5-16A

5.4.14 2XXXS Chart Drive Processor Board Assembly (896073) Divide-By Switch Speed

1. Turn recorder off. Connect frequency counter to J3 pin 4. Turn recorder on. Select a chart speed of 25 mm/sec. Measured frequency should be 1.994 ±.5 Hz (502 ±2 msec). If not, repeat steps 6 thru 11 in Section 5.4.13.

2. Set 6 position DIP Switch SW2 to /100 (see Figure 5-16A). Select a chart speed of 2 mm/sec. Measured frequency should be 159.5 ±.5 Hz (6.27 ± .02ms). Select Stop.

3. Set DIP Switch SW2 to /60 (see Figure 5-16A). Select a chart speed of 200 mm/sec. Measured frequency should be 265.9 ± .7 Hz (3.76 ±.02 ms). Select Stop.

4. Set DIP Switch SW2 to /1000 (see Figure 5-16A). Select a chart speed of .2 mm/sec. Measured frequency should be 15.95 ±.04 Hz (62.7 ±.15 ms). Select Stop.

NOTE: ÷1000 setting is not recommended for ink recorders. Ink bleeding on the paper may occur at the very slow chart speeds.

5. Set DIP Switch SW2 to appropriate divide-by setting (see Figure 5-16A).

5.4.15 Baud Rate Frequency Measurements (for Recorder with Annotation)

1. Turn recorder off. Connect a frequency counter to TP3. Turn recorder on. Set DIP switch SW2 for 300 baud rate (see Figure 5-16A). Measured frequency should be 2400 Hz ±.3% (2392.8 Hz thru 2407.2 Hz).

2. Check frequencies for all baud rates listed in Figure 5-16A. All frequencies measured should be within ±.3%.

Baud	Freq. Hz
300	2,400 ±7.2
600	4,800 ±14.4
1,200	9,600 ±28.8
2,400	19,200 ±57.6
9,600	76,800 ±230.4
14,400	115,200 ±345.6
19,200	153,600 ±460.8

3. Return DIP Switch SW2 to the 300 baud rate (see Figure 5-16A).

5.4.16 Remote Voltage (for Recorder with Annotation)

1. With a chart speed of 5 mm/sec, measure the voltage between TB101-2 and -6 with a D.C. meter. TB101-6 is common. The voltage should measure 28V ±20% D.C.

5.4.17 Battery Voltage (for Recorder with Annotation)

1. Turn recorder off. Connect a DVM to J6 pin 8 (Processor Board). Voltage measured should be 4 to 6 VDC.

5.5 TROUBLESHOOTING

5.5.1 General

This section provides troubleshooting hints to assist the operator and/or serviceman in locating malfunctions that are the possible causes and remedy. If a problem exists which is not identified in this section, contact the factory for assistance.

5.5.2 Electrical Power Malfunctions

MALFUNCTION	CAUSE	REMEDY
1. Recorder inoperative (Power ON and INTERLOCK lamps are extinguished with POWER ON switch depressed.	a. Recorder not connected to power source.	a. Connect to power source.
	b. Fuse F709 blown	b. Replace fuse.
	c. POWER ON switch defective.	c. Replace switch.
2. Recorder inoperative (POWER ON and INTERLOCK lamps are illuminated.	a. Chart Paper torn or supply is depleted.	a. Rethread or replace chart paper.
	b. INTERLOCK switch defective.	b. Replace switch.

5.5.3 Chart Drive Malfunctions

MALFUNCTION	CAUSE	REMEDY
1. Inoperative	a. Desired chart SPEED button not depressed.	a. Depress desired chart speed button.
	b. Drive belt worn or broken.	b. Replace drive belt.
	c. Jumper between pins 3 & 4 of TB101 missing.	c. Replace jumper.
	d. Fuse F709 blown.	d. Replace fuse.
	e. Motor defective.	e. Replace motor.
	f. Chart speed switch defective.	f. Replace Switch Board Assy.
	g. Relay K701 defective.	g. Replace relay.
	h. Defective Power Supplies.	h. Troubleshoot Power Supplies.
	i. Defective Switching Amp.	i. Troubleshoot Switching Amp Board.
2. Inoperative on divide-by speed.	a. Broken wire.	a. Replace wire.
	b. Switch defective	b. Replace switch.
3. Chart runs intermittently only at 200mm/sec speed.	a. Sensor Board Assembly.	a. Replace.
4. Chart speed not accurate or is erratic.	a. Drive roll worn excessively.	a. Clean or replace drive roll.
	b. Processor Board bad.	b. Refer to Sec. 5.4.13.

5.5.4 Writing System Malfunctions

MALFUNCTION	CAUSE	REMEDY
1. Trace missing or faint.	a. Ink supply exhausted.	a. Replace ink cartridge.
	b. Screw on ink cartridge not fully counterclockwise.	b. Turn screw fully counterclockwise.
	c. Ink manifold valves not in full ON position.	c. Rotate to full ON position.
	d. Pens clogged.	d. Clean or replace pens.
	e. Ink manifold solenoid defective.	e. Replace solenoid.
	f. Ink manifold solenoid de-energized.	f. Fuse F711 blown-replace fuse.
	g. Air in system.	g. Bleed System.
2. Trace heavy or wet; pen gouges paper.	a. Pen excessively worn.	a. Replace pen.
	b. Pen not properly lapped.	b. Lap pen.
	c. Improper pen pressure.	c. Adjust pen pressure.
3. All pens not on same time line.	a. Pen(s) out of alignment.	a. Align pen(s).
4. Pen fails to return to same position each time.	a. Loose pen.	a. Align and tighten pen.
	b. Loose penmotor linkage.	b. Replace penmotor.

5.5.5 Signal Malfunctions

MALFUNCTION	CAUSE	REMEDY
1. Trace unusually wide.	a. Noise appearing at the pen tip.	a. Check input signal and connections. Defective drive amplifier or pre-amplifier boards; repair or replace.
2. No signal on any or all channels.	a. Drive amplifier or pre-amplifier defective.	a. Replace drive amplifier or preamplifier.
	b. Drive amp fuse(s) blown.	b. Replace fuse(s) after correcting malfunction.
	c. Chart speed stop switch defective.	c. Replace switch.
3. Pens limp or biased	a. Drive amplifier or preamplifier defective.	a. Repair or replace drive amplifier or preamplifier.
	b. Recorder requires calibration.	b. Calibrate recorder.
	c. Pen loose.	c. Align and tighten pen.
	d. Defective pen position pot.	d. Replace pen position pot.

5.6 SUBASSEMBLY REPLACEMENT

5.6.1 Solenoid Valve Assembly Replacement

NOTE: Refer to illustrated parts breakdown of recorder assembly in Section VI.

WARNING: MAKE SURE POWER IS TURNED OFF AND RECORDER IS DISCONNECTED FROM POWER SOURCE.

Replace solenoid valve assembly (item 9) as follows:

1. Remove recorder from case per paragraph 5.3.6 (if recorder is rack mounted, slide recorder completely out of rack).

2. Turn OFF ink cartridge (Activating Screw, Figure 5-12).

NOTE: If solenoid only is to be replaced, turning ink off is not required.

3.* Remove Drive Amp board(s) and/or panel filler (for 1 channel recorder) from rear of recorder.

4.* In cavity left by Drive Amp board remove and retain 2 screws and washers in area of Drive Amp board connectors. Solenoid Valve Assembly will fall away from opposite side of bracket wall.

5. Place paper towels around area underneath solenoid valve assembly.

6. If entire assembly is to be replaced perform the following:

   a. Disconnect yellow and orange leads from solenoid terminals. Tag leads.

   b. Pull ink tubing from both valve nipples.

   c. Make connections to new solenoid valve assembly in reverse order of "a" and "b" above. Attach assembly to bracket wall.

   d. It may be desirous to bleed the inking system at this point. Refer to paragraph 5.3.5 for procedure.

7. If solenoid and diode only are to be replaced perform the following:

   a. Disconnect yellow and orange leads from solenoid terminals. Tag leads.

   b. Remove and retain cotter pin connecting solenoid plunger and valve link.

   c. Remove and retain 2 screws and washers from solenoid housing. Solenoid diode assembly will fall away from housing.

   d. Install new solenoid/diode assembly and make connections in reverse order of "a", "b" and "c" above. Attach solenoid valve assembly to bracket wall.

8.* Install Drive Amp board(s) and/or panel filler.

9. Install recorder in case (or rack).

*Only necessary on 2200 models.

5.6.2 Manifold Assembly Replacement

NOTE: Refer to illustrated parts breakdown of recorder assembly in Section VI.

Replace manifold assembly (item 34) as follows:

1. Remove recorder from case per paragraph 5.3.6 (if recorder is rack mounted, slide recorder a little more than halfway out of rack).

2. Turn OFF ink cartridge and solenoid ink valve.

3. Place paper towels around area underneath manifold assembly.

4. Pull off ink tubing from manifold to pens and manifold to ink cartridge.

5. Remove four machine screws which secure manifold assembly to side plates. Lift out manifold assembly.

6. Install new or repaired manifold assembly.

7. Replace ink tubing to manifold assembly.

8. Turn ON ink cartridge and solenoid ink valve. Check for leaks.

9. Bleed the inking system per paragraph 5.3.5.

10. Install recorder in case or slide recorder into rack and secure.

5.6.3 Table Assembly Replacement

NOTE: Refer to illustrated parts breakdown of Recorder Assembly and Writing Table Assembly in Section VI.

1. Remove recorder from case per paragraph 5.3.6 (if recorder is rack mounted, slide recorder a little more than halfway out of rack).
2. Remove paper supply roll per paragraph 5.2.1.
3. Remove timing belt and pulley assembly from R.H. Plate Assembly.
4. Remove retaining rings from table arms and carefully pry arms out of plate assemblies. Do not bend arms.
5. Tilt table slightly and pull out of recorder, removing right and left hand lever assemblies.
6. Mount new or repaired table assembly on lever assemblies. Slide table into recorder and snap arms into side plate holes. Replace retaining rings, pulley assembly and timing belt.
7. Replace paper supply roll and install recorder in case (or rack).

5.6.4 Stepper Motor Replacement

NOTE: Refer to illustrated parts breakdown of Recorder Assembly, Section VI.

WARNING: MAKE SURE POWER IS TURNED OFF AND RECORDER IS DISCONNECTED FROM POWER SOURCE.

Remove the Motor (M109) as follows:

1. Remove recorder from case per paragraph 5.3.6 (if recorder is rack mounted, slide recorder completely out of rack).
2. Remove rear cover assembly. (Contains AC power cord and TB101.) Move cover away from rear of recorder. (If it becomes necessary to disconnect any leads, make sure they are tagged).
3. Remove the Power Supply board, by removing the four screws located at the bottom of recorder.
4. Remove timing belt from small (9 tooth) pulley.
5. Remove the four motor mounting nuts located on side of recorder, and remove the motor.
6. Remove and retain 9-tooth pulley (gear) from motor shaft.
7. Install 9-tooth pulley (gear) on shaft of new motor.
8. Install new motor in reverse order of the above procedure.

5.6.5 Chart Drive or Control Transformer Replacement (T109)

WARNING: MAKE SURE POWER IS TURNED OFF AND RECORDER IS DISCONNECTED FROM POWER SOURCE.

1. Remove recorder from case per paragraph 5.3.6 (if recorder is rack mounted, slide recorder a little more than halfway out of rack).
2. Remove rear cover assembly. (Contains AC power cord and TB101.) Move cover away from rear of recorder. (If it becomes necessary to disconnect any leads, make sure they are tagged.
3. Remove Power Supply board per paragraph 5.6.5. Steps 1, 2, and 3.
4. Remove Drive Amplifier Board.
5. Remove two screws holding transformer in place.
6. Install new transformer in reverse order of steps 3, 4, and 5.

5.6.6 Power Transformer Replacement (T101 to T108**)

NOTE: Refer to illustrated parts breakdown of chassis assembly in Section VI.

**NOTE:

T101 to T108 dependent upon number of channels in recorder. If recorder is 2, 4 or 6 channel version, remove paper supply roll per paragraph 5.2.1 to gain access to transformers. If recorder is eight channel version, remove paper supply roll per paragraph 5.2.1 for T103 to T108. Remove rear cover assembly from recorder assembly to gain access to T101 or T102. Install new transformer in reverse order.

WARNING: MAKE SURE POWER IS TURNED OFF AND RECORDER IS DISCONNECTED FROM POWER SOURCE.

Replace power transformer(s) (item 51) as follows:

1. Remove recorder from case per paragraph 5.3.6. (If recorder is rack mounted, slide recorder a little more than halfway out of rack.)
2. Remove paper supply roll per paragraph 5.2.1.
3. Remove 4 screws securing transformer to chassis.
4. Note terminal/color code lead connections while disconnecting lugs and before transformer removal.

NOTE: Twelve connections per transformer as follows:

1. **Eight lugs on top of transformer.**
2. **Four leads at bottom of transformer which terminate at J101.**

5. Remove defective transformer thru hole in front of recorder.
6. Install new transformer in reverse order of steps 3, 4 and 5.
7. Install paper supply roll.
8. Install recorder in case (or rack).

5.6.7 Penmotor Replacement

NOTE: Refer to illustrated parts breakdown of recorder assembly and penmotor bar assembly.

WARNING: MAKE SURE POWER IS TURNED OFF AND RECORDER IS DISCONNECTED FROM POWER SOURCE.

Remove penmotor as follows:

1. Remove recorder from case per paragraph 5.3.6. (If recorder is rack mounted, slide recorder a little more than halfway out of rack.)
2. Remove paper supply roll per paragraph 5.2.1.

NOTE: To make room for penmotor to be removed from recorder assembly the manifold and valve solenoid assemblies must first be removed. Refer to paragraphs 5.6.1 and 5.6.2.

3. Remove pen assembly by loosening 2 screws which secure it to drive arm. Slide pen down and away from penmotor. Refer to Figure 5-6.
4. Remove 2 socket head screws which mount penmotor to penmotor bar. Disconnect connector and remove penmotor from recorder.
5. Install new penmotor in reverse order of procedure above.
6. Install recorder in case (or in rack).
7. Perform calibration on penmotor drive amp after completing installation.

5.6.8 Replacing Penmotor Drive Band (684999)

CAUTION: IT IS RECOMMENDED THAT THE DRIVE BAND BE REPLACED AT THE FACTORY SO THAT PROPER BAND TENSION IS MAINTAINED. SHOULD FIELD REPLACEMENT BECOME NECESSARY, PERFORM THE FOLLOWING STEPS.

NOTE: Refer to Figure 5-17 for location of parts in capital letters.

a. Band Removal

1. Remove Analog Pen Assembly.
2. Loosen (but do NOT remove) screws securing FRONT and REAR BAND CLAMPS.
3. Remove DRIVE BAND by sliding FREE END in counterclockwise direction from between REAR CLAMP and ANCHOR, then from between FRONT CLAMP and PULLEY.
4. Conclude removal by gently unhooking band from BAND ANCHOR.

b. Band Replacement

1. Place hooked (or bent) end of DRIVE BAND over ANCHOR as shown, and reinstall in clockwise direction between FRONT CLAMP and PULLEY, then between REAR CLAMP and ANCHOR.

2. Apply 5.5 to 6.5 pounds tension to FREE END OF BAND with a spring clamp and spring tension scale or equivalent.

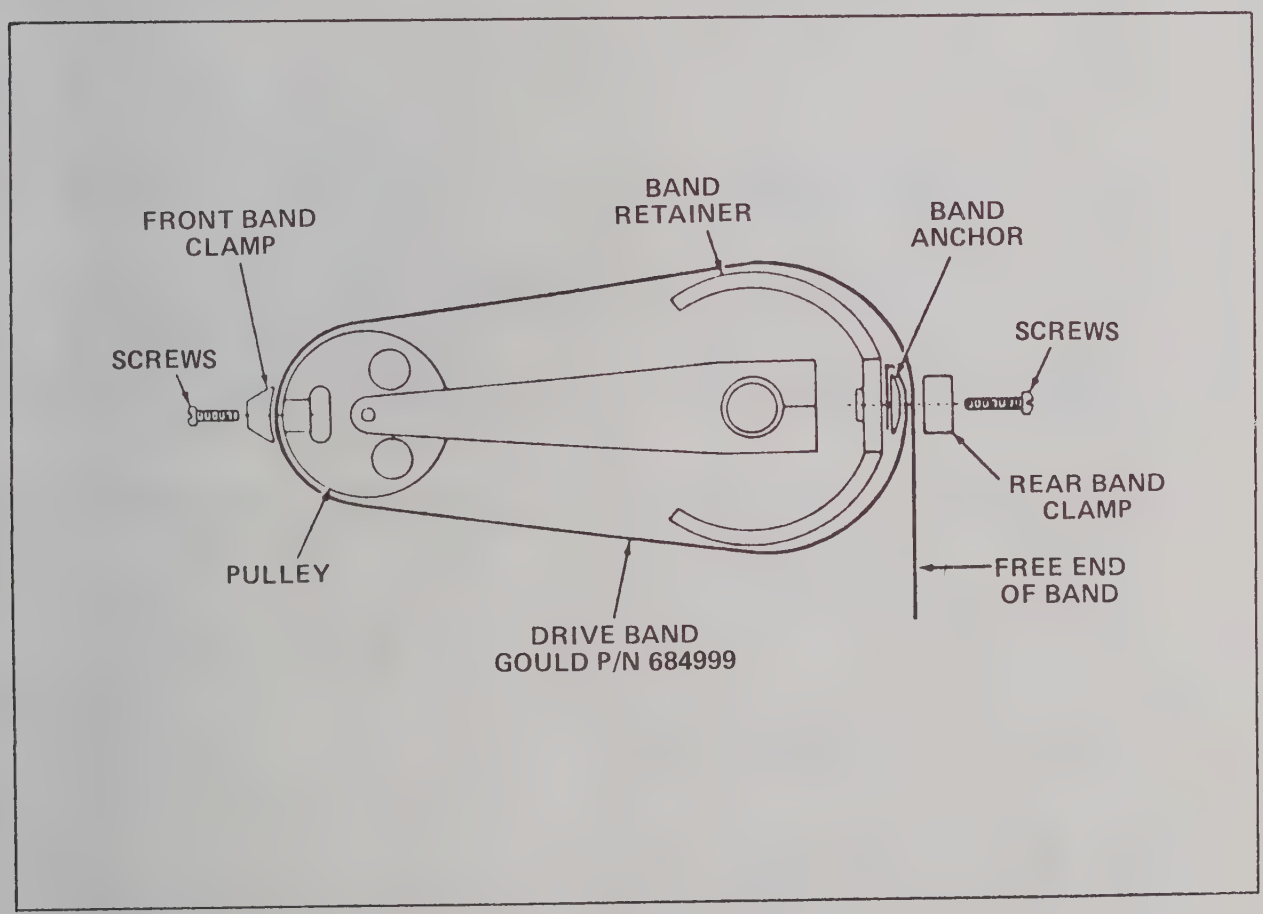
NOTE: Be sure that tension is applied directly in line with band i.e., does not pull band forward or back.

3. Maintaining tension, fully tighten all screws and apply a drop of Red Glyptal or equal at screwheads and mating surfaces.

4. Remove spring scale and spring clamp.

5. Reinstall Analog Pen.

6. Check frequency response for compliance with specifications given in Section I.



PENMOTOR DRIVE BAND PARTS IDENTIFICATION
FIGURE 5-17

5.7 STACK TO STACK CALIBRATION (Option)

(See Figure 6-23, 6-24 if 8 chan.)
(See Figure 6-20, 6-21 if 6 chan.)

5.7.1 Equipment Needed

1. Fish scale or equivalent - (range 0 to 32 oz.).
2. End Wrench, 3/8 inch (number 10 nut).
3. Allen Wrench Set (to fit number 8 socket screw).
4. Screwdriver, number 2 size.
5. Machinist - Square.

5.7.2 Mechanical Alignment

1. Hinged section of supply drawer front panel should be adjusted to approximately 5 degrees from horizontal, i.e., toward vertical closed position. A cable support bracket on each side is adjusted to accomplish this. With proper adjustment, the cables should both be taut, with the spring levers against their respective stops. Support bracket lugs are to be aligned vertically with angled ends toward the hinge before adjustment.
2. Supply compartment hinged panel should be closed and secured with panel screws during use. Slotted mount holes are provided in the angle bracket supporting the panel to allow for panel centering adjustment and the rail spacers and nut bars may be moved to ease thumbscrew alignment.
3. Take-up drawer must be in a fully extended detent lock position during use. Adjust front slide bracket positions on rack rails to center panel when closed.
4. The removable tray of the take-up drawer must sit flat with the front of the tray resting against lanced sections of the drawer bottom.
5. The paper pressure defeat arm in the recorder must be against the stop in a clockwise mode when using "Z" fold paper. It must be against the other stop in a counter-clockwise mode when using roll paper. Push the brake arm in the sideplate slot rearward to set the ROLL/FANFOLD arm.
6. No pins, screws, etc., shall extend beyond inside surfaces of the paper supply compartment. These will cause tearing of the paper edges.
7. No painting voids or globs shall be present along hinge of trim panel.

5.7.3 Calibration Procedure

1. Depending on mounting facility, i.e., rack, cabinet, the stack-to-stack drawers should be centered to the recorder as accurately as possible.
2. The cradle section of supply drawer, which holds the paper should be installed square to the supply drawer itself, initially. The "C" brackets supporting the Supply Compartment should hang squarely from the recorder rack mount slides.
3. Make sure the standard roll paper mandrel is in place with the new paper core supplied. The core tube notch must be at the left side of the mandrel to get the flange position at design center. Do not crush the core tube by overtightening the screw-on flange.
4. Check that the Pressure Defeat Arm on inside right of recorder side plate is placed in the clockwise "Z-fold" position.
5. In the paper compartment, spring forces for brake pad tension are preset to 18 oz. (left side) and 26 oz. (right side) with a -1 or +2 oz. tolerance. Socket head screws mounted in the levers are turned in or out and locked with the nuts provided to set tension. A minimum of 8 oz. + 1/2 differential force must be maintained. Measurement is made at the pin where the spring is attached to the moving arm. The wire loops may be removed temporarily to allow the hinged panel to open fully (when Recorder is extended on slides) so that the spring scale can be pulled in a line parallel to the brake bar slot. Measure force when tension screw leaves or just touches the end of the brake bar.

6. A stack of paper is placed within the hinged panel supply cavity of the supply drawer. Orient paper for Channel 1 to the left. The grid lines on the first sheet of paper must face away from the operator. Seat the stack flat in the compartment.

7. Making sure that the writing side of the paper is facing the felt brake pad, the brake and roller is moved outward and the paper is threaded between the roller brake bar and pad. See threading diagram on hinged panel.

8. Paper is fed directly up through the BOTTOM of the recorder and up and over the mandrel and writing table. Be sure the power is off and that you do not damage the pens.

9. The hinged supply door panel is closed and secured with the panel screws.

10. Paper is fed through the slot at the bottom of the writing table, around the drive roller, and then positioned to right alignment line before the table is closed.

11. Turn on recorder to a speed of 50 mm/sec. Paper should move to a point within 1/16th inch of the line and stabilizer in a few pages. If it does not, the paper supply compartment must be repositioned to make the paper locate from the left mandrel flange. Check that the paper is hugging the left supply compartment sidewall at the brake pad and that the threaded roller turns, as paper is used (with hinged door almost closed).

12. Orient paper in take-up drawer to assure proper bending and folding (same bend direction as on supply pack).

5.7.4 Inspection Procedure

1. Check to see that paper tension is adequate for proper writing.

2. Paper should align itself for writing with 3 to 6 sheets.

3. Chart wander should not exceed ±5 mm (distance of left event marker trace from left edge of paper).

4. Run recorder at various speeds to check folding and chart wander characteristics.

SECTION VI

PARTS IDENTIFICATION

6.1 GENERAL

This Gould 2800S Series Recorder has been accurately calibrated and adjusted before shipment from the factory, and should give long trouble-free service. For servicing beyond the scope of the instructions contained in this manual or the technical equipment available, contact your nearest Gould Service Engineer listed on the warranty card shipped with the recorder.

The following parts lists, exploded views, and schematic diagrams are designed to assist in servicing and repairing the recorder. For replacement parts, refer to the appropriate Figure and Parts List that follow. The individual items listed do not necessarily imply that they are a procurable part, as some are for reference purposes only.

Schematic drawings are in the appendix (rear section) of this Manual.

To assure prompt and satisfactory delivery of replacement parts, include the following information with your purchase order:

1. Name and model number of the instrument.
2. Description of part as listed in this manual.
3. Gould part number.

NOTE: Do not use the SYMBOL NUMBER from the parts list for identifying desired parts on the order.

6.2 ATTACHING PARTS

(A-P) indicates that the following parts, up to -- -- -- -- -- * -- -- -- -- --, are Attaching Parts; i.e., unillustrated hardware required to attach the preceding item to the assembly.

2800S RECORDER — Portable Models W/O Preamps
MODEL 2107-8800-0X
FIGURE 6-1

ITEM NUMBER	PART NUMBER	DESCRIPTION
	2107-8800-XX	2800S Recorder, 8-Channel
1	887149	Case Assembly, Recorder - W/O preamps (See Figure 6-2)
2	2107-8890-XX	Recorder Assembly (See Figure 6-12 and 6-13) (A-P)
	31-119918-0212	Screw, Mach, Pan Hd.
	1-118195-309	Washer, Plain
	1-216741-430	Lockwasher, Plain
	8-249616-0205	Screw, Mach, Pan Hd. - Painted
	10-120053-104	Lockwasher, Ext. Tooth
		------*------
3	11-6402-12	Take-Up Assembly - Per Customer Order (See Figure 6-11) (A-P)
	266046	Pulley
	236865-3	Pin, Cotter
	31-119918-8208	Screw, Mach, Pan Hd.
	1-216741-425	Lockwasher, Spring
		------*------
4	292819	Shim (A-P)
	13-262715-4004	Screw, Self Tapping
		------*------

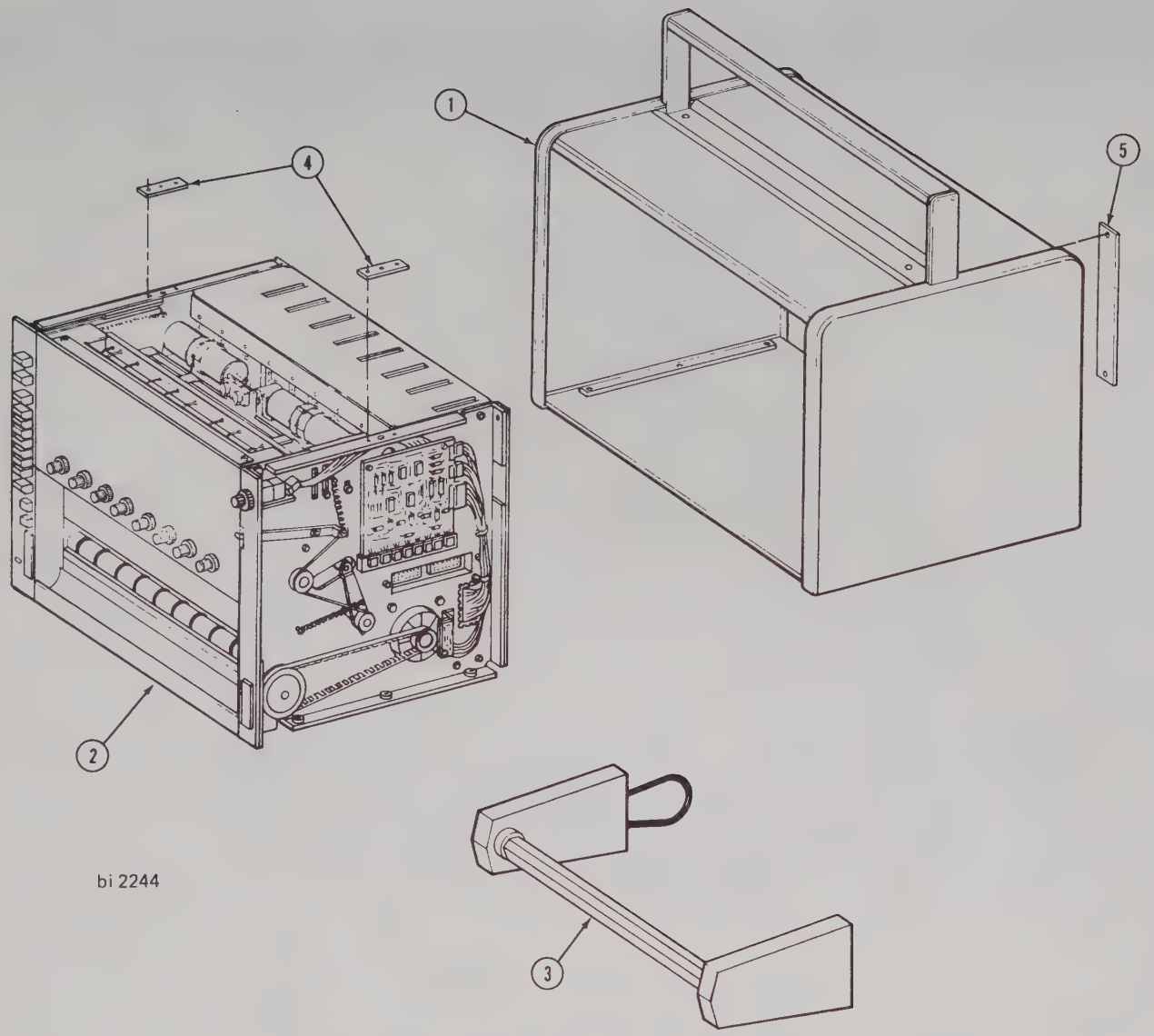


FIGURE 6-1 2800S SERIES RECORDER, PORTABLE LESS PREAMPS

2800S RECORDER – PORTABLE MODELS
CASE ASSEMBLY WITHOUT PREAMPS
FIGURE 6-2

ITEM NUMBER	PART NUMBER	DESCRIPTION	SYMBOL NUMBER
	887149	Case Assembly (w/o Preamps)	
1	487141	Saddle, Recorder	
2	287185	Bar, Support (A-P)	
	13-262716-8206	Screw, Self Tapping	
		-----*-----	
3	486075-1	Guide, Right (A-P)	
	13-262716-6210	Screw, Self Tapping	
		-----*-----	
4	486075-2	Guide, Left (A-P)	
	13-262716-6210	Screw, Self Tapping	
		-----*-----	
5	686051-5	Cover, Front & Rear	
6	486081	Panel, Side (A-P)	
	13-281598-6208	Screw, Thread Cutting	
		-----*-----	
7	686049-13	Cover, Center (A-P)	
	13-262716-8206	Screw, Self Tapping	
		-----*-----	
8	1-232736-16	Tape, Teflon	
9	785099-5	Handle Assy	
10	286048	Support, Handle (A-P)	
	31-119924-4508	Screw, Mach, Hex Hd.	
	8-120052-109	Lockwasher	
		-----*-----	
11	267451-2	Mounting Feet, Pair (A-P)	
	13-262716-6210	Screw, Self Tapping	
		-----*-----	

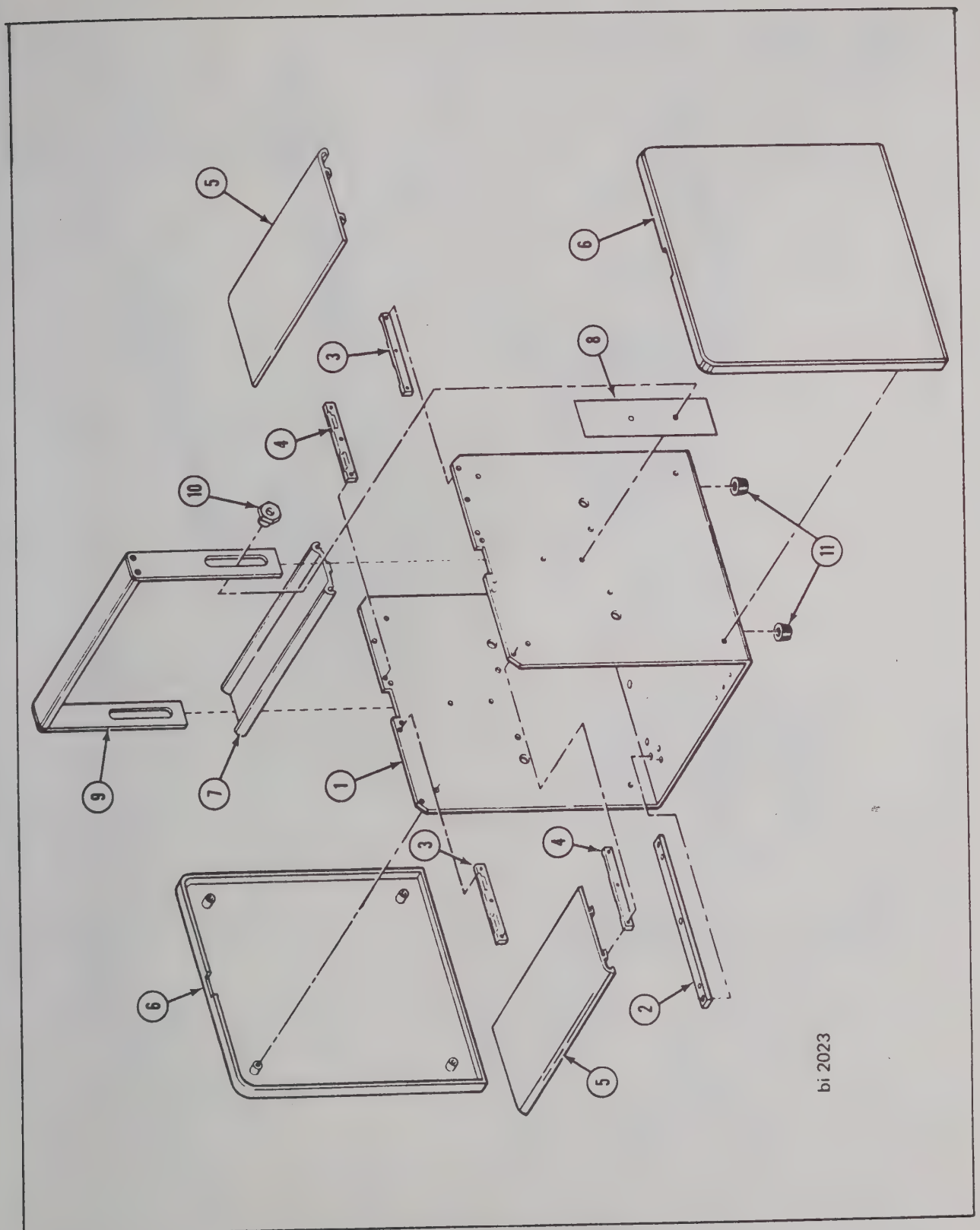


FIGURE 6-2 CASE ASSEMBLY

2800S RECORDER — Portable "Flip-Top" Box w/Plug-In Preamps
MODEL 2107-8801-0X
FIGURE 6-3

ITEM NUMBER	PART NUMBER	DESCRIPTION
	2107-8801-0X	Recorder Assy
1	687539	Panel Assy (A-P)
	248352-0218	Screw
		_____*_____
2	294027	Bracket, Zee (A-P)
	31-119918-0208	Screw, Mach, Pan Hd.
	1-216741-430	Lockwasher, Spring
	1-118195-309	Washer, Plain
		_____*_____
3	11-1202-25	Cage Assy (See Figure 6-5)
4	893928-1	Case Assy (See Figure 6-4)
5	287599	Bracket (A-P)
	13-262716-4004	Screw, Self Tapping
		_____*_____
6	124804-6	Clamp, Cable (A-P)
	31-119918-4008	Screw, Mach, Pan Hd.
	1-118195-305	Washer, Plain
		_____*_____
7	2108-8893-XX	Recorder Assy, Ink (See Figure 6-12 & 6-13) (A-P)
	31-119918-0212	Screw, Mach, Pan Hd.
	1-216741-430	Lockwasher, Spring
	1-118195-309	Washer, Plain
		_____*_____

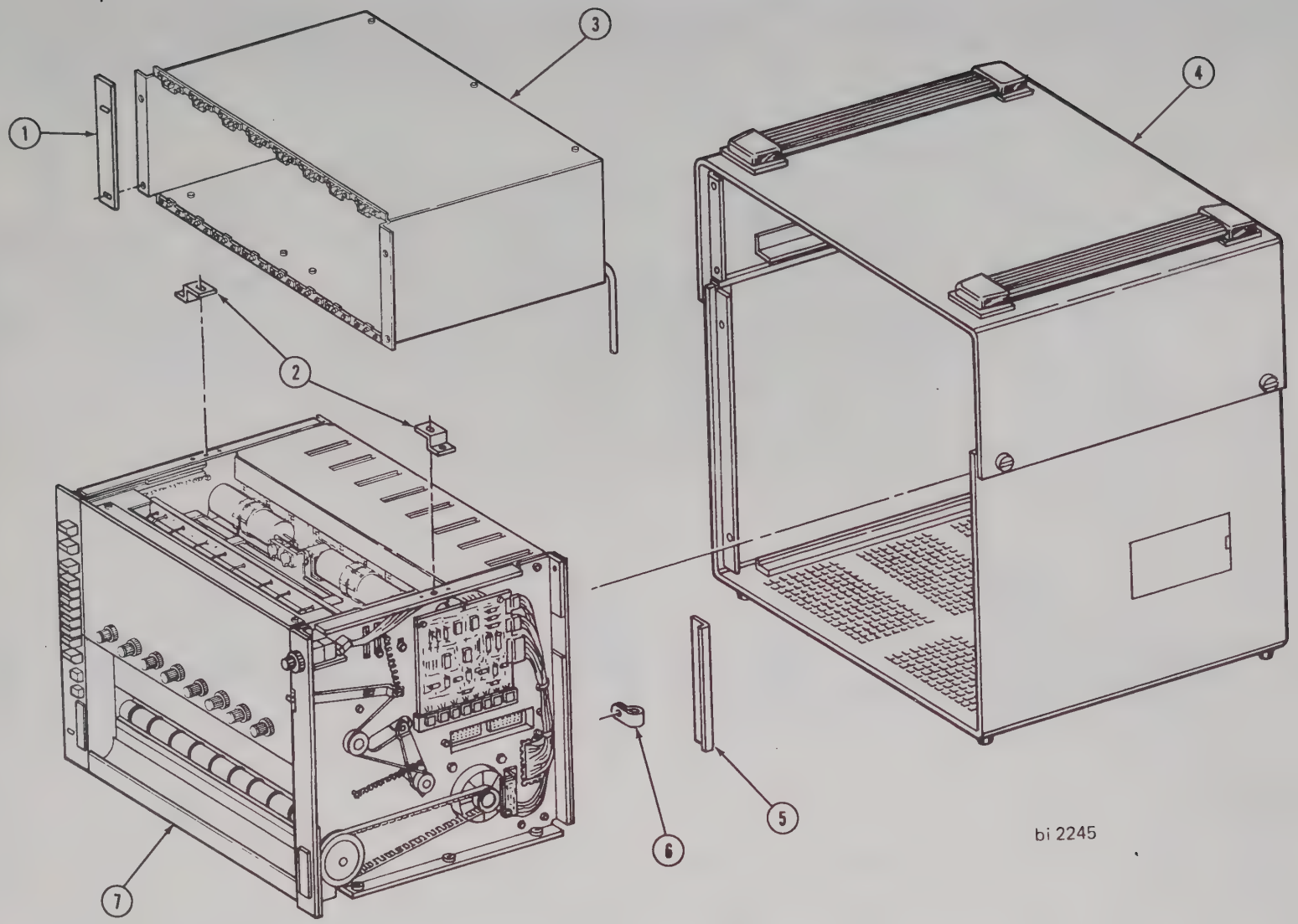


FIGURE 6-3 2800S SERIES RECORDER, PORTABLE W/PREAMP CAGE

2800S RECORDER – PORTABLE MODELS
CASE ASSEMBLY – FLIP-TOP BOX W/PLUG-IN PREAMPS
FIGURE 6-4

ITEM NUMBER	PART NUMBER	DESCRIPTION
	893928-1	Case Assy
1	689851	Support, Handle
		(A-P)
	31-119918-6207	Screw, Mach, Pan Hd.
	1-216741-420	Lockwasher, Spring
	31-119918-0207	Screw, Mach, Pan Hd.
		-----*-----
2	286097-2	Strap, Handle
3	685518-4	Handle
4	693940	Strap
5	893657	Case Assy, Upper
6	293789	Anchor, Rod
		(A-P)
	31-119918-6205	Screw, Mach, Pan Hd.
	1-216741-420	Lockwasher, Spring
		-----*-----
7	270148-6	Screw, Shoulder
8	293790-2	Rod, Support
9	293931	Clamp
		(A-P)
	31-119918-6207	Screw, Mach, Pan Hd.
	31-119998-62	Nut, Hex
	31-119918-6204	Screw, Mach, Pan Hd.
		-----*-----
10	240704-04	Nut, Self-Locking
11	293925	Screw, Shoulder
12	293788	Screw, Shoulder
13	287185	Bar, Support
		(A-P)
	13-262716-8206	Screw, Self Tapping
		-----*-----
14	242461-45	Nut, Self Locking
15	263475	Washer
16	293652	Door
17	693827	Hinge, Modified
		(A-P)
	13-262716-6204	Screw, Self Tapping
	31-119918-6202	Screw, Mach, Pan Hd.
		-----*-----
	893655	Case Assy, Lower
18	393791	Spacer, L.H.
19	393792	Spacer, R.H.
		(A-P)
	31-119918-4002	Screw, Mach, Pan Hd.
		-----*-----
20	493654	Case, Lower
21	267451-2	Mounting Feet
		(A-P)
	13-262716-6206	Screw, Self Tapping

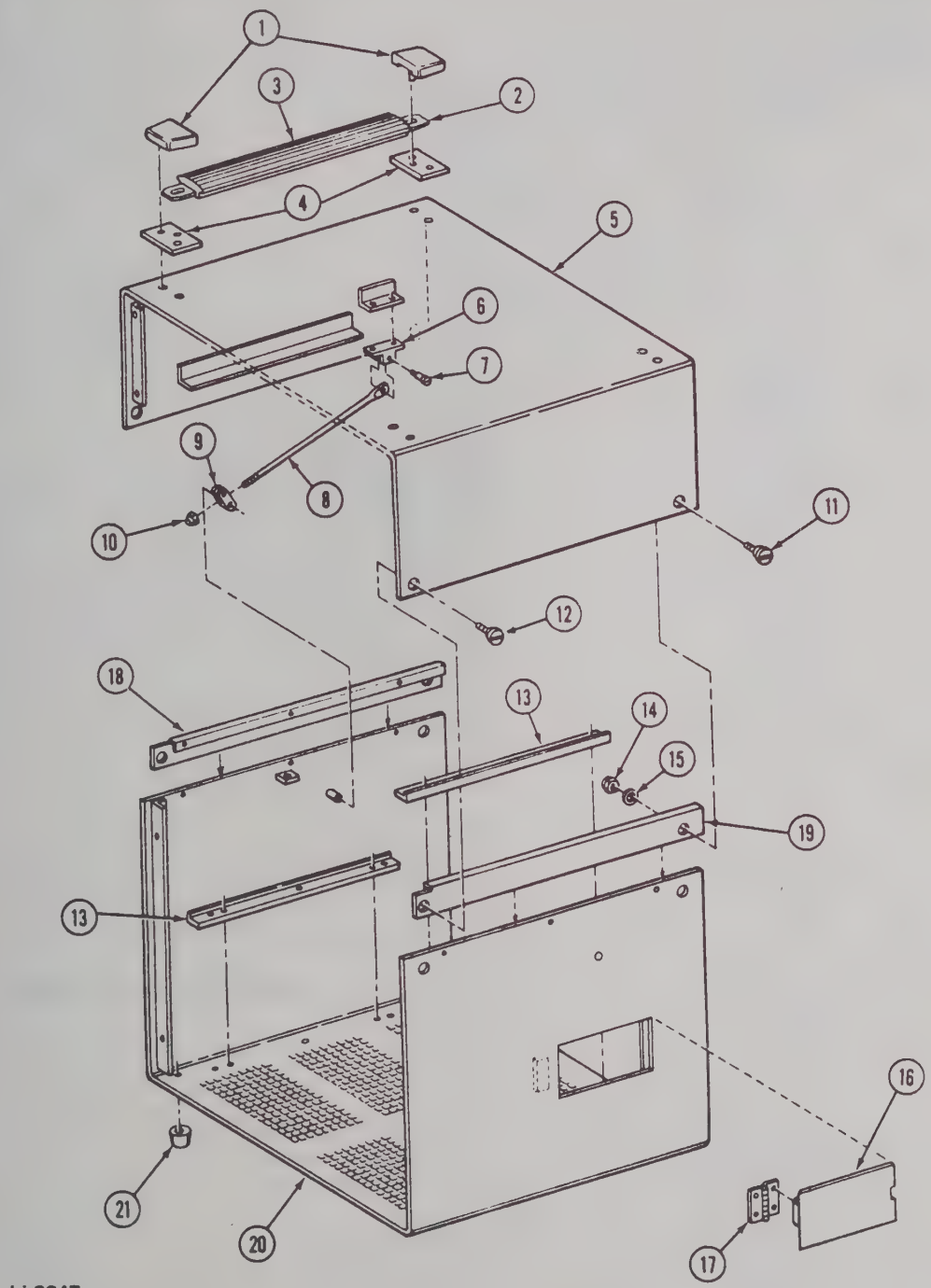


FIGURE 6-4 CASE ASSEMBLY, FLIP-TOP BOX W/PLUG-IN PREAMPS

2800S RECORDER
PREAMP CAGE FOR FLIP-TOP BOX W/ PLUG-IN PREAMPS, MODEL 11-1202-25 (Wrg Diag 292500)
FIGURE 6-5

ITEM NUMBER	PART NUMBER	DESCRIPTION	SYMBOL NUMBER
	11-1202-25	Pre-Amp Cage Assy	
1	294036	Support	
		(A-P)	
	31-119918-6205	Screw, Mach, Pan Hd	
		-----*-----	
2	386058-2	Guide, Pre-Amp	
		(A-P)	
	13-262716-2604	Screw, Self-Tapping	
		-----*----	
3	786056-1	Guide, Engraved	
4	786056-2	Guide, Engraved	
5	786056-3	Guide, Engraved	
6	786056-4	Guide, Engraved	
7	786056-5	Guide, Engraved	
8	786056-6	Guide, Engraved	
9	786056-7	Guide, Engraved	
10	786056-8	Guide, Engraved	
		(A-P)	
	13-262716-2604	Screw, Self-Tapping	
		-----*-----	
11	487553	Enclosure, Pre-Amp	
	892580	Panel Assy	
		(A-P)	
	13-262716-8204	Screw, Self-Tapping	
		-----*-----	
12	232660-7	Clamp	
		(A-P)	
	1-118195-304	Washer, Plain	
	1-216741-411	Lockwasher, Spring	
	31-119918-4005	Screw, Mach, Pan Hd.	
		-----*-----	
13	286052	Screw, Shoulder	
		(A-P)	
	262565-2	Washer, Flat (between screw head and panel)	
	0-240731-10	Ring, Retaining	
		-----*-----	
	892396	Harness Assy	
		(A-P)	
	31-119918-4008	Screw, Mach, Pan Hd.	
	1-216741-411	Lockwasher, Spring	
	31-119918-4005	Screw, Mach, Pan Hd.	
		-----*-----	
14	286410-16	Connector	XA201-XA208
15	1-283408-1	Contact, Elec.	
16	232997-23	Strap, Retaining	
17	241026-2	Term, Lug	
18	241026-4	Term, Lug	
19	292420	Strain, Relief Clamp	
20	270153-2	Contact, Elec.	

2800S RECORDER
PREAMP CAGE FOR FLIP-TOP BOX W/ PLUG-IN PREAMPS, MODEL 11-1202-25 (Wrg Diag 292500)
FIGURE 6-5 (Continued)

ITEM NUMBER	PART NUMBER	DESCRIPTION	SYMBOL NUMBER
21	0-270155-1	Connector, Elec.	P203, P204
	792395	Harness Assy (A-P)	
	31-129175-4008	Screw, Mach, Fil Hd.	
		------*------	
22	288490-1	Board, Terminal	TB201
23	232997-23	Strap, Retaining	
24	1-283408-2	Contact, Elec.	
25	892394	Panel, Subassy	

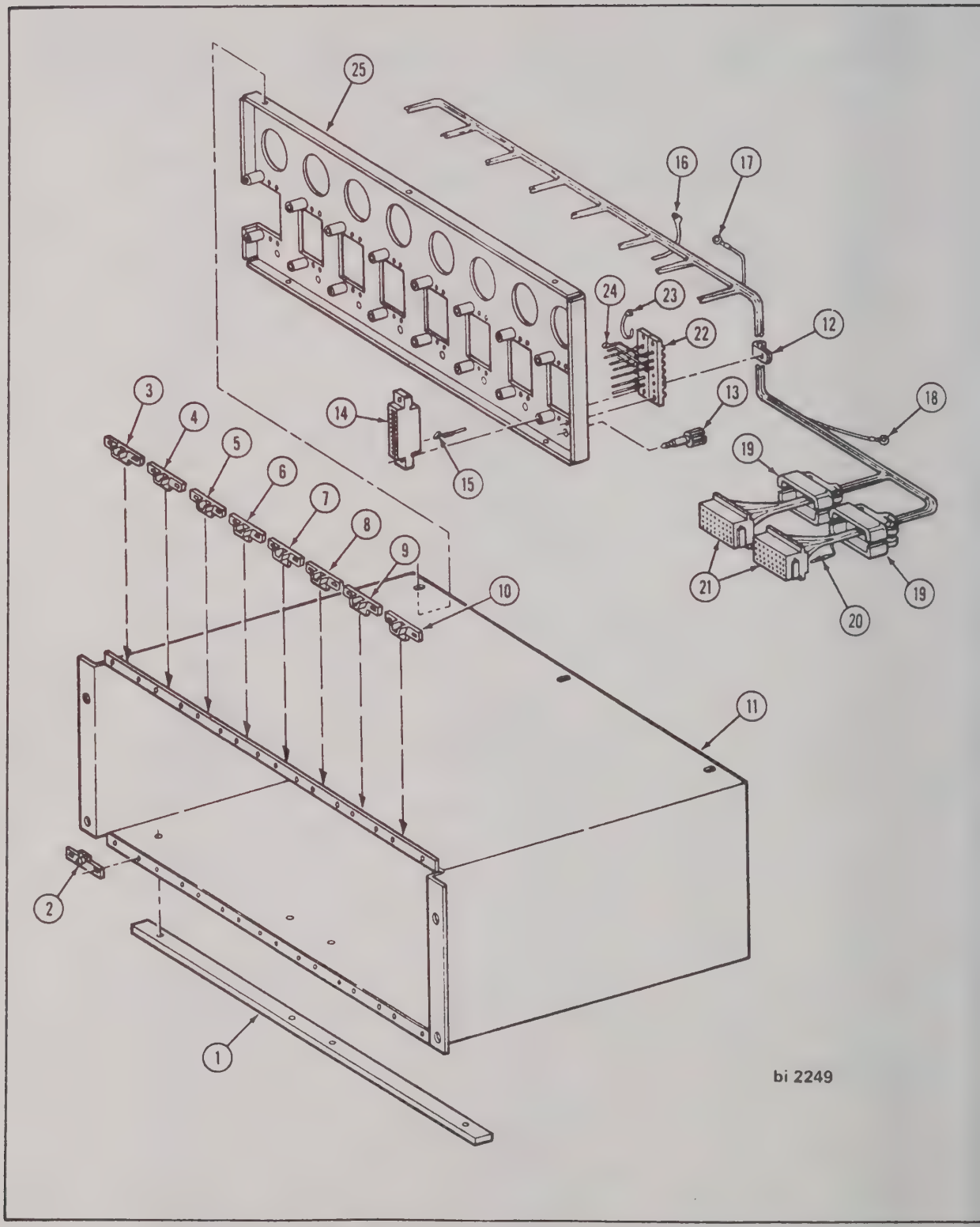


FIGURE 6-5 PREAMP CAGE FOR FLIP-TOP BOX W/PLUG-IN PREAMPS

2800S RECORDER – Portable "Flip-Top" Box w/892035 Preamp Panel
MODEL 2107-8809-0X
FIGURE 6-6

ITEM NUMBER	PART NUMBER	DESCRIPTION
	2107-8809-0X	Recorder/Pre-Amp 2800S Portable
1	294027	Bracket, Zee
		(A-P)
	1-118195-309	Washer, Plain
	31-119918-0208	Screw, Mach, Pan Hd.
		-----*-----
2	892035	8-Channel Preamp Assy (See Manual P/N 892035)
		(A-P)
	248352-0218	Screw
		-----*-----
3	893928	Case Assy (See Figure 6-7)
4	287599	Bracket
		(A-P)
	13-262716-4004	Screw, Self Tapping
		-----*-----
5	124804-6	Clamp, Cable
		(A-P)
	31-119918-0208	Screw, Mach, Pan Hd.
	1-118195-305	Washer, Plain
		-----*-----
6	2007-8890-XX	Recorder Assy, Ink (See Figure 6-12 and 6-13)
		(A-P)
	31-119918-0212	Screw, Mach, Pan Hd.
	1-216741-430	Lockwasher, Spring
	1-118195-309	Washer, Plain
		-----*-----

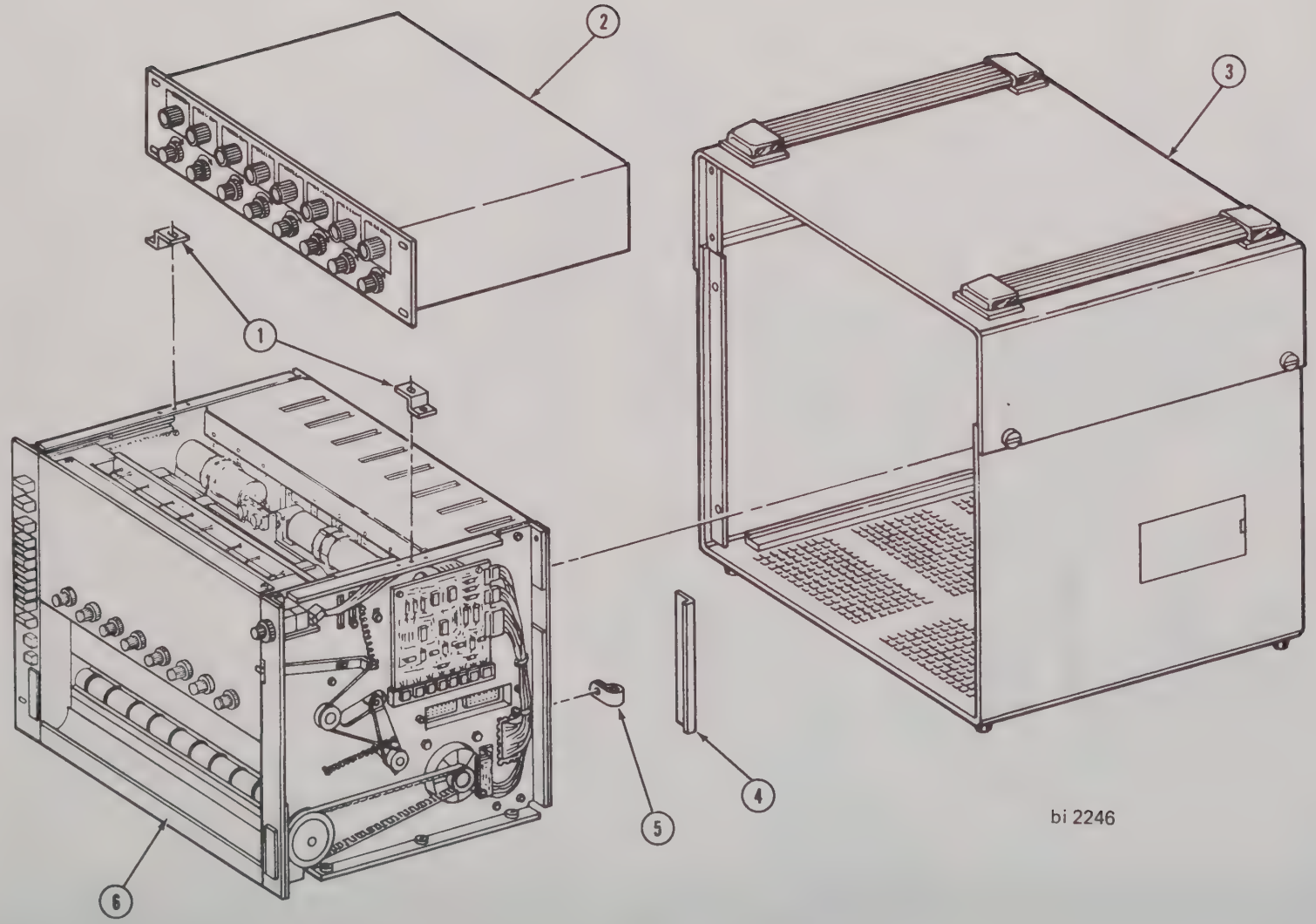


FIGURE 6-6 2800S SERIES RECORDER, PORTABLE W/FIXED PREAMPS

2800S RECORDER – PORTABLE MODELS
CASE ASSEMBLY – FLIP-TOP BOX W/892035 PREAMP PANEL
FIGURE 6-7

ITEM NUMBER	PART NUMBER	DESCRIPTION
	893928	Case Assy
1	689851	Support, Handle
		(A-P)
	31-119918-6207	Screw, Mach, Pan Head
	1-216741-420	Lockwasher, Spring
	31-119918-0207	Screw, Mach, Pan Head.
		-----*-----
2	286097-2	Strap, Handle
3	685518-4	Handle
4	693940	Strap
5	893782	Case Assy, Upper
6	293789	Anchor, Rod
		(A-P)
	31-119918-6205	Screw, Mach, Pan Hd.
	1-216741-420	Lockwasher, Spring
		-----*-----
7	270148-6	Screw, Shoulder
8	293790-1	Rod, Support
9	293931	Clamp
		(A-P)
	31-119918-6207	Screw, Mach, Pan Hd.
	31-119998-62	Nut, Hex
	31-119918-6204	Screw, Mach, Pan Hd.
		-----*-----
10	240704-04	Nut, Self-Locking
11	293925	Screw, Shoulder
12	293788	Screw, Shoulder
13	287185	Bar, Support
		(A-P)
	13-262716-8206	Screw, Self Tapping
		-----*-----
14	242461-45	Nut, Self Locking
15	263475	Washer
16	293652	Door
17	693827	Hinge, Modified
		(A-P)
	13-262716-6204	Screw, Self Tapping
	31-119918-6202	Screw, Mach, Pan Hd.
		-----*-----
	893655	Case Assy, Lower
18	393791	Spacer, L.H.
19	393792	Spacer, R.H.
		(A-P) For 18 & 19
	31-119918-4002	Screw, Mach, Pan Hd.
		-----*-----
20	3-129275-107	Nut Clinch
21	493654	Case, Lower
22	267451-2	Mounting Feet
		(A-P)
	13-262716-6206	Screw, Self-Tapping
		-----*-----

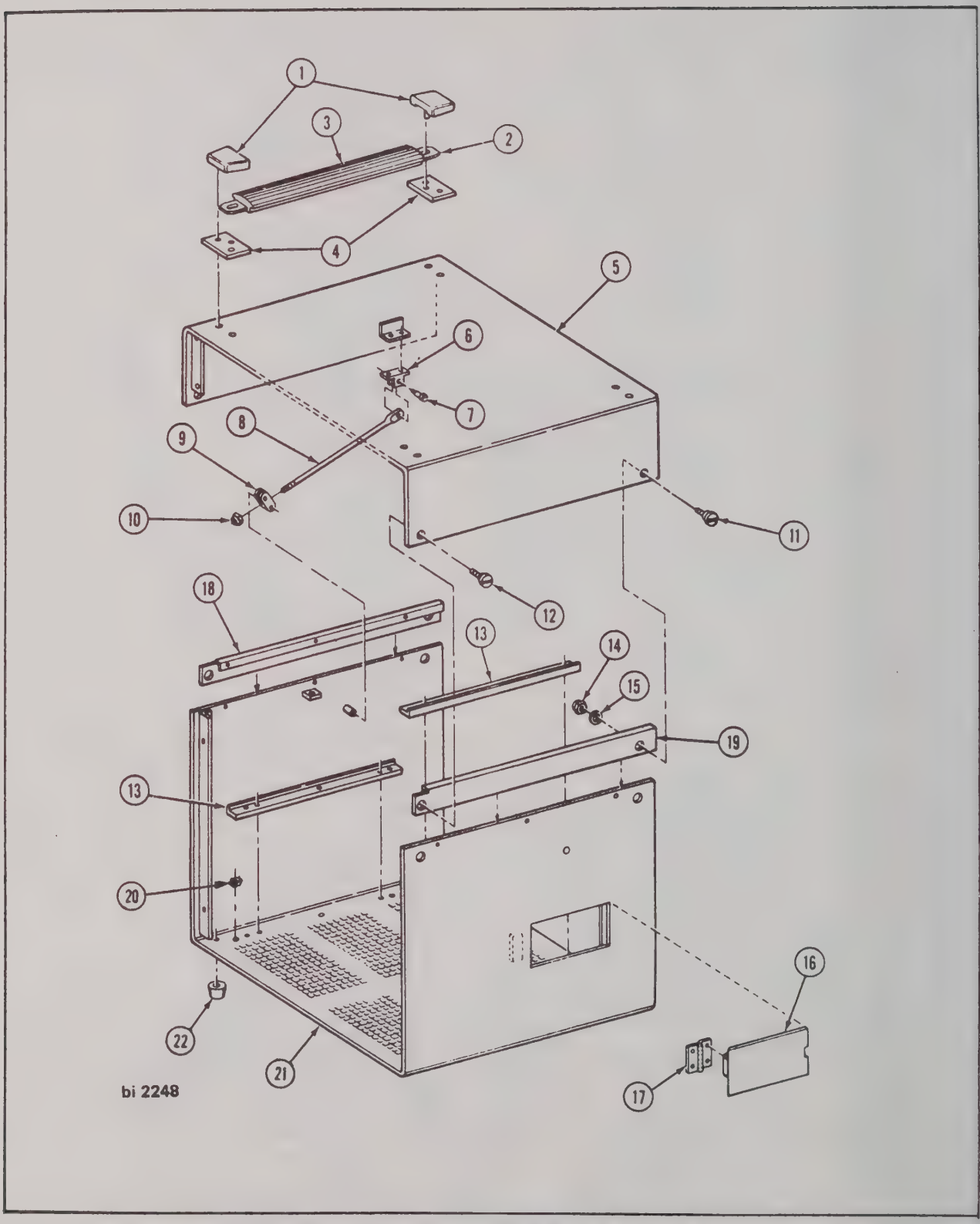


FIGURE 6-7 CASE ASSEMBLY, FLIP-TOP BOX W/892035 PREAMP PANEL

2800S RECORDER - RACK MOUNT MODELS
FIGURE 6-8

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
1	210X-8890-XX	2800S Recorder, 8 Channel (Figure 6-12, 6-13)	
2	467037	Frame, Shipping (per customer order)	
3	11-1154-61	Cabinet Assembly (per customer order)	
4	11-6402-12	Chart Take-Up Assembly (per customer order) (See Figure 6-11) (A-P)	
	266046	Pulley	
	236865-3	Pin, Cotter	
	31-119918-8208	Screw, Mach. Pan Hd.	
	1-216741-425	Lockwasher, Spring	
		-- -- -- -- -- * -- -- -- -- --	
	**688007	Rack Mount Kit Assembly, Model 11-1202-14 (for complete parts and installation, see Figure 6-9) (Rack Mount Installation Instructions, Recorder only, see Paragraph 2.13)	
5	1-461006	Panel	
11	1-216741-430	Lockwasher No. 10	
18	248352-0218	Screw 10-32 X 1-1/8	
21	13-262716-8204	Screw 8-32 X 1/4 Pan	
24	270903-14	Clamp	
27	1-118195-309	Washer No. 10	
29	31-119924-0208	Screw 10-32 X 1/2 Hex	
Not Shown	**688088	Rack Mount Kit Assembly, Model 11-1202-15 (See separate manual)(Rack Mount Installation Instructions, Recorder and Preamp Cage)	
Not Shown	884206-5	Power Kit - 115 VAC (Per model specified) (See Figure 6-33)	
Not Shown	884206-6	Power Kit - 230 VAC (Per model specified) (See Figure 6-33)	
Not Shown	884208-5	Power Kit - 115 VAC (Per model specified) (See Figure 6-33)	
Not Shown	884208-6	Power Kit - 230 VAC (Per model specified) (See Figure 6-33)	

**Use Kit Model number for ordering purposes.

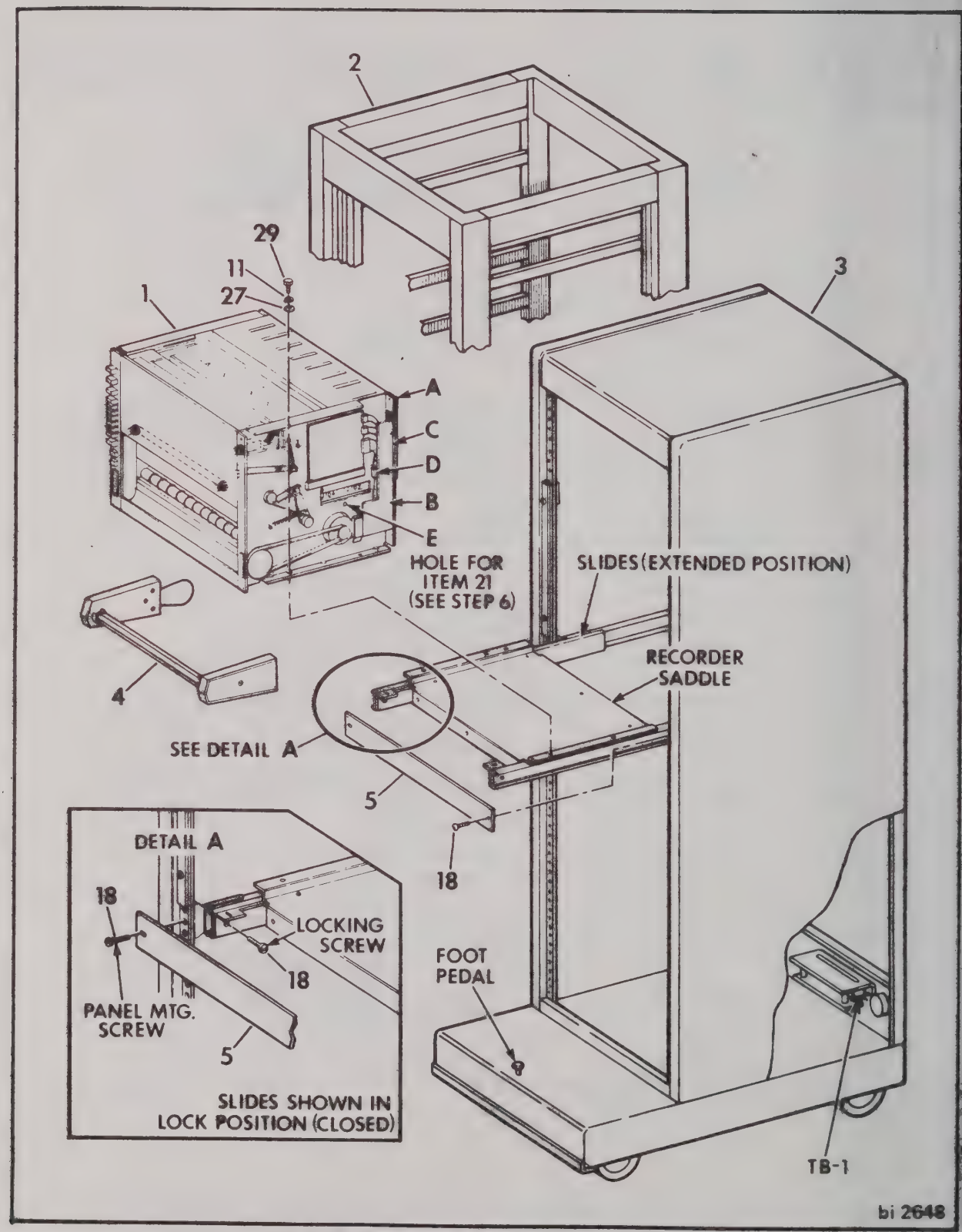
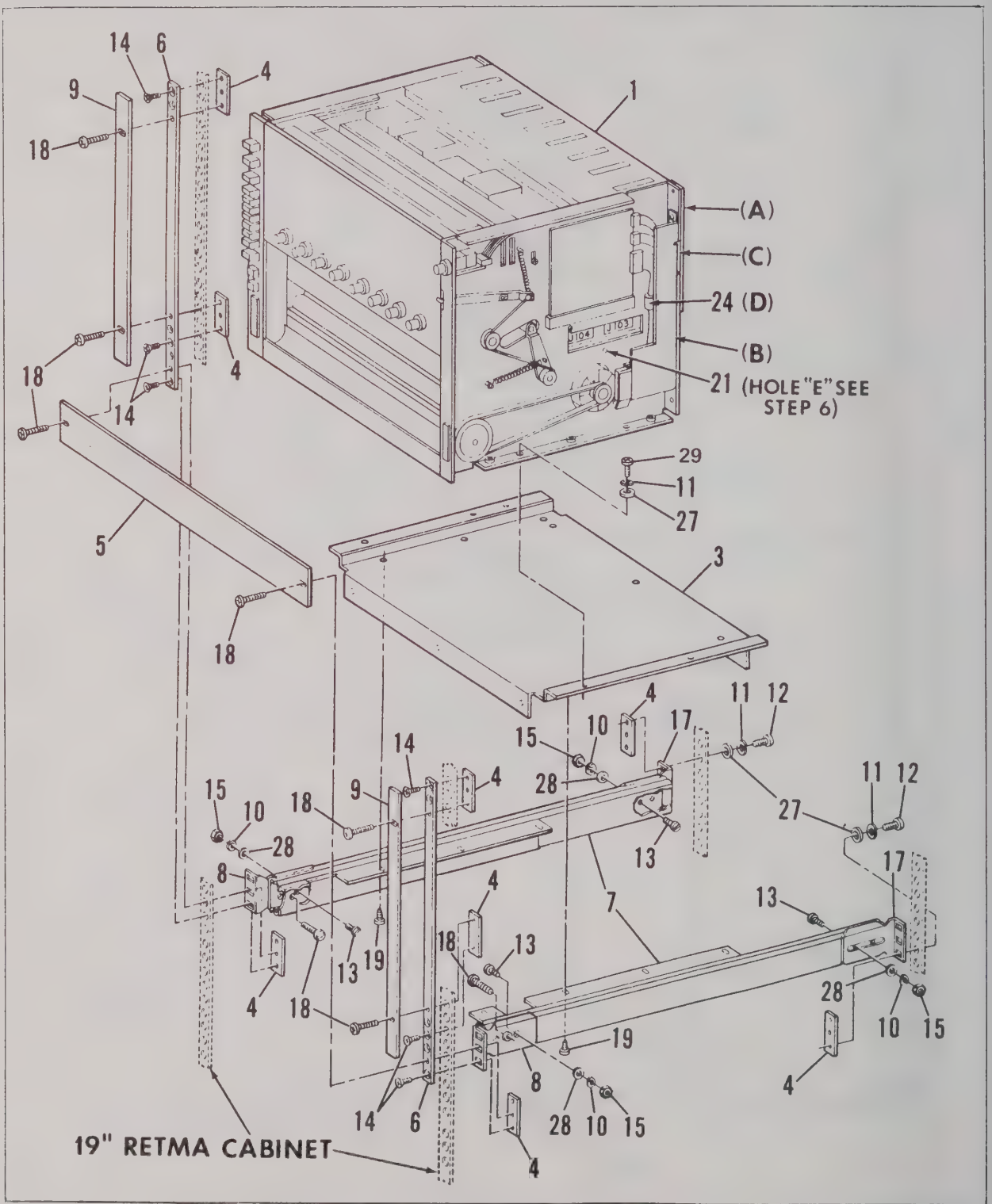


FIGURE 6-8 2800S SERIES RECORDER, RACK-MOUNT

2800S SERIES RECORDER - ALL RACK MOUNTED MODELS
RACK MOUNT KIT - MODEL 11-1202-14
FIGURE 6-9

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
	11-1202-14	Rack Mount Kit	
1	210X-XXXX-XX	• Recorder Assy. (Not part of Rack Mount Kit)	
2		• Not Used	
3	887560	• Saddle Assy.	
4	287148	• Nut Plate	
5	1-461006	• Panel	
6	287583	Spacer	
7	696687	Slide, Pair	
8	696822	Bracket, Front	
9	287660	Panel, Filler	
10	1-216741-425	Lockwasher No. 8	
11	1-216741-430	Lockwasher No. 10	
12	31-119918-0208	Screw 10-32 x 1/2 Pan	
13	31-119918-8206	Screw 8-32 x 3/8 Pan	
14	31-119920-0208	Screw 10-32 x 1/2 Flat	
15	31-119998-82	Nut 8-32	
16		Not Used	
17	287610-3	Bracket, Rear	
18	248352-0218	Screw 10-32 x 1 1/8	
19	13-262716-8204	Screw 8-32 x 3/8 Pan	
20		Not Used	
21	13-262716-8204	Screw 8-32 x 1/4 Pan	
22	270903-12	Clamp (Not shown)	
23		Not Used	
24	270903-14	Clamp	
25		Not Used	
26		Not Used	
27	1-118195-309	Washer No. 10	
28	1-118195-307	Washer No. 8	
29	31-119924-0208	Screw 10-32 X 1/2 Hex	

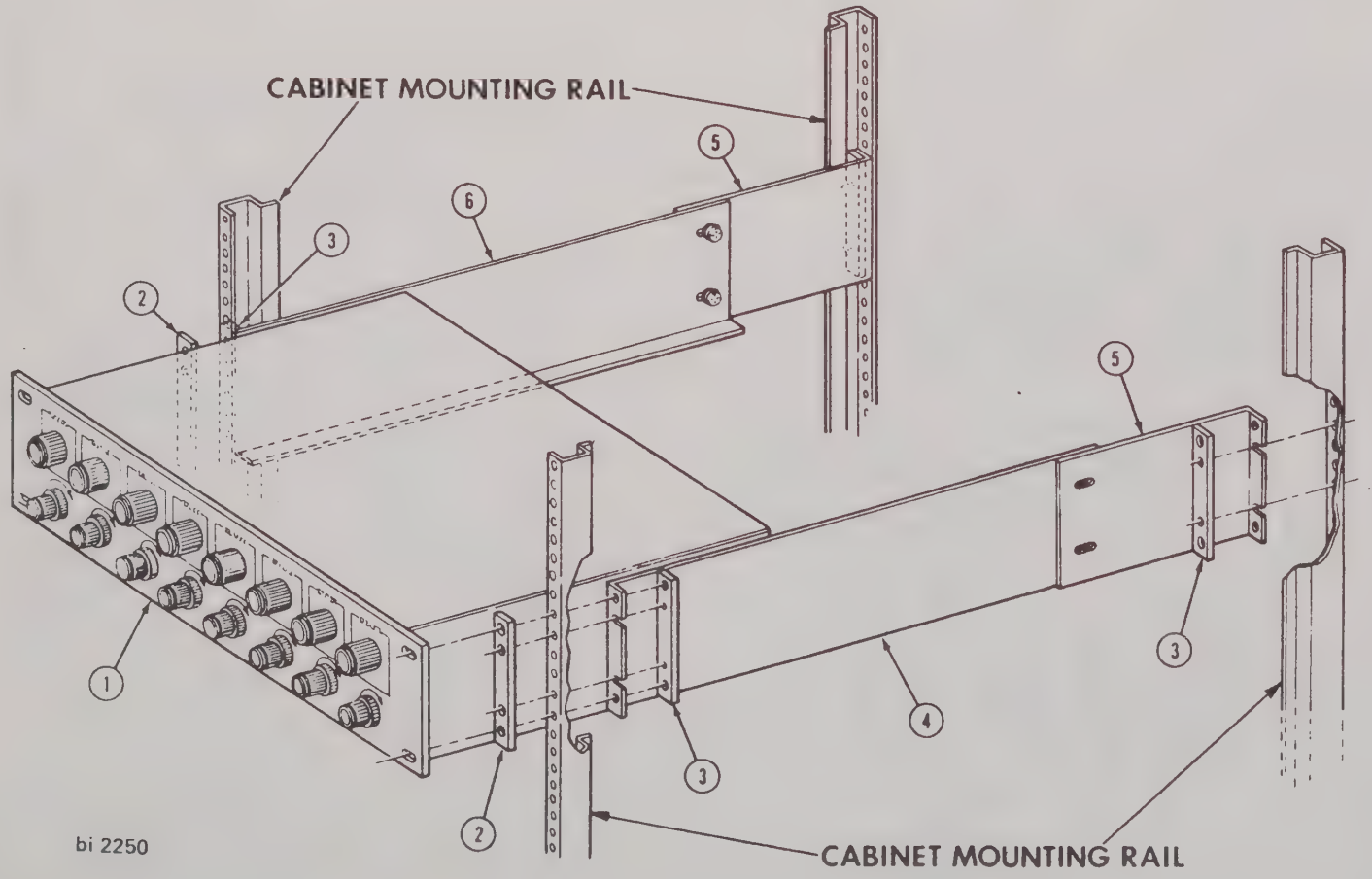
NOTE: **See Paragraph 2.12 for installation instructions.**



RACK MOUNT INSTALLATION RECORDER ONLY
FIGURE 6-9

2800S RECORDER - ALL MODELS
RACK MOUNT FOR PREAMP PANEL 11-1202-27
FIGURE 6-10

ITEM NUMBER	PART NUMBER	DESCRIPTION
	11-1202-27	Rack Mount Kit
1	892035	Preamp Panel Assy (See Manual P/N 892035) (A-P)
	248352-0218	Screw
	294077-3	Washer, Countersunk
	13-262715-6206	Screw, Flat Head
		_____*_____
2	294146	Plate, Spacer (A-P)
	31-119920-6208	Screw, Mach, Flat Head
		_____*_____
3	294145	Plate, Nut
4	394148	Slide, R.H.
5	294147	Bracket, Slide (A-P)
	31-119918-0208	Screw, Mach, Pan Head
	31-119998-02	Nut, Hex
	1-216741-430	Lockwasher, Spring
	1-118195-309	Washer, Plain
		_____*_____
6	344149	Slide, L.H.


CABINET MOUNTING RAIL
5
6
3
2
5
1
3
4
3
2
bi 2250
CABINET MOUNTING RAIL

2800S RECORDER – ALL MODELS
CHART TAKE-UP ASSEMBLY 11-6402-12
FIGURE 6-11

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
	11-6402-12	Chart Take-Up Assy (A-P)
	31-119918-8206	Screw, Machine
	1-216741-425	Lockwasher
		-----*-----
1	249617-4	Plate Cover – L.H. (A-P)
	8-249616-6203	Screw, Machine
		-----*-----
2	243867-12	"O" Ring (Belt)
3	246651	Roller, Guide
4	246307	Block
5	236865-3	Cotter Pin
6	266046	Pulley (Slide onto recorder drive roll.)
7	9-249640-8206	Screw Fl. Hd.
8	767254-5	Arm Assembly, L.H.
9	687339	Shaft Assembly
10	247523-116	Plate, Ident. Mod. No.
11	767249-5	Arm, Right
12	249618-4	Plate Cover – R.H. (A-P)
	8-249616-6203	Screw, Machine
		-----*-----
13	267253	Spring, Compression
14	266184	Shaft, Shouldered
15	667251	Shaft Assembly, Shouldered
16	243696	Retainer, Bearing (A-P)
	31-119916-2604	Screw, Machine
		-----*-----
17	267257	Pulley

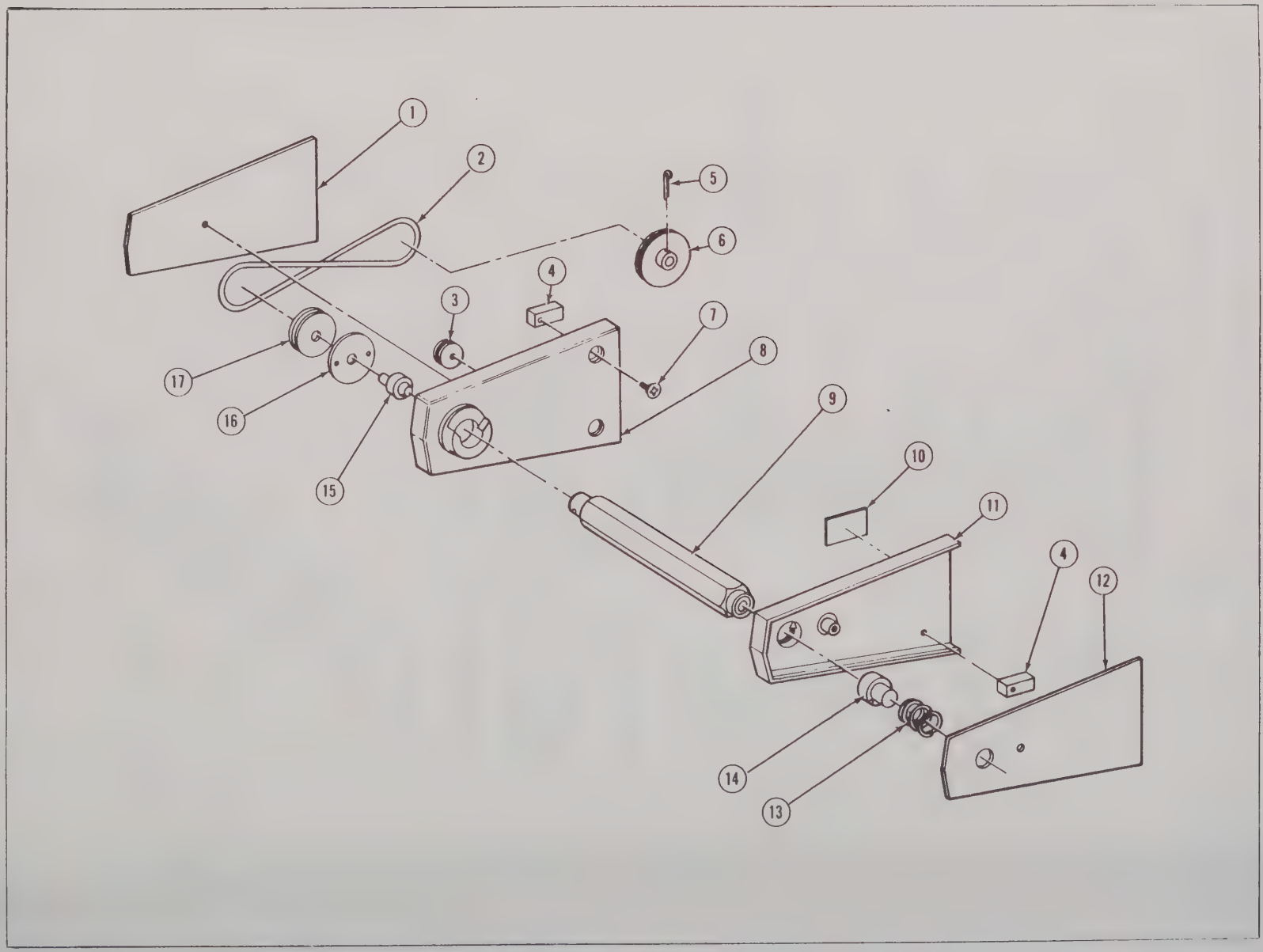


FIGURE 6-11 CHART TAKE-UP ASSEMBLY

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
	2107-8890-XX	Recorder Assembly	
1	284169-2	Spacer	
2	242461-45	Nut	
3	893620-1	Board Assembly, Speed Select (See Figure 6-27)	
3A	396997	Insulator (A-P)	
	1-118195-304	Washer	
	31-119918-4004	Screw	
		-- -- -- -- -- * -- -- -- -- --	
4	294518	Insulator, Speed Select (some units use item 4, others 4A)	
	31-119918-6206	Screw	
4A	496876	Clear Plastic Cover	
	31-119918-4006	Screw	
4B	3-280875-15	Threaded Standoff, use with item 4A	
5	796710	Cable, Thumbwheel	J7
6	796715	Cable Assembly, RS232	J8
7	894717-1	Harness	J5
7A	694371-12	Cable Assembly, Flat, Sensor	J1
7B	694371-13	Cable Assembly, Flat, Variable Speed	J4
8	694371-11	Cable Assembly, Flat, Switching Amplifier	J2
9	896712	Cable Assembly, Image Head	J9
10	894717-1	Harness	J3
10A	694371-25	Cable Assembly, Flat, Supply	J6 (on processor)
10B	894717-1	Harness	J2 (on power supply)
10C	894717-1	Harness	J5 (on power supply)
10D	894717-1	Harness	J1 (on power supply)
10E	696815	Cable Assembly with Battery	J6 (on power supply)
11	896073	Board Assembly, Processor/Microcomputer (See Figure 6-31)	
12	789763	Pen Assembly, Ink	
13	687477-1	Tube	
14	787753	Manifold Assembly (A-P)	
	31-119918-6205	Screw	
	1-118195-305	Washer	
	1-216741-420	Lockwasher, Spring	
		-- -- -- -- -- * -- -- -- -- --	
15	887752	Valve Assembly, Solenoid (A-P)	
	31-119918-6205	Screw	
	1-118195-305	Washer	
	1-216741-420	Lockwasher, Spring	
		-- -- -- -- -- * -- -- -- -- --	

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
16	11-2730-01	Ink Cartridge (See Warning Note on page 5.3)	
17	766243	Ink Plunger Assembly (A-P)	
	31-119918-4004	Screw	
	1-118195-304	Washer	
		-- -- -- -- -- * -- -- -- -- --	
18	666582	Tube	
19	887749	Bar Assembly, Pen Motor (See Figure 6-17) (A-P)	
	20-119922-0208	Screw, Cap	
	1-216741-430	Lockwasher, Spring	
		-- -- -- -- -- * -- -- -- -- --	
20	666587-1	Tube	
21	11-2873-20	Pen Assembly, Ink	
22	396818	Insulator, Processor	
23	285711	Spring	
24	Not Used		
25.	694917	Power Receptacle Assembly (96795) (A-P)	
	243898-40	Nut	
	31-119918-4006	Screw	
		-- -- -- -- -- * -- -- -- -- --	
26	Not Used		
27	245538	Connector (mates with 245537) (A-P)	
	31-119918-4004	Screw	
	243898-40	Nut	
		-- -- -- -- -- * -- -- -- -- --	
28	1-280875-8	Spacer, Threaded	
29	289225-4	Shield (A-P)	
	31-119918-4004	Screw	
	1-120052-203	Lockwasher, Int. Tooth	
		-- -- -- -- -- * -- -- -- -- --	
30	129699	Jumper	
31	1-286155-24	Board, Terminal	
32	896593	Cover Assembly, Rear (A-P)	
	13-262716-4004	Screw	
	1-120052-203	Lockwasher, Int. Tooth	
		-- -- -- -- -- * -- -- -- -- --	
33	287599	Cover, Rear (A-P)	
		-- -- -- -- -- * -- -- -- -- --	
34	294546	Insulator, Switching Amplifier	
35	893618	Board Assembly, Switching Amplifier (See Figure 6-26) (A-P)	
		-- -- -- -- -- * -- -- -- -- --	

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
36	694371-8	Cable Assembly, Flat	J4 (on power supply)
37	294161	Insulator, Heat Sink	
38	894133	Board Assembly, Optical Sensor (See Figure 6-30) (A-P)	
		-- -- -- -- -- * -- -- -- -- --	
39	286531	Spring	
40	694293	Brake Assembly (See Figure 6-19) (A-P)	
	31-119923-0204	Screw, Set	
	31-119918-4003	Screw	
		-- -- -- -- -- * -- -- -- -- --	
41	286592	Spring	
42	243542-13	Belt, Timing	
43	694520	Pulley, Modified (A-P)	
	14-119923-6203	Screw, Set	
		-- -- -- -- -- * -- -- -- -- --	
44	123913	Washer, Spacer	
45	127271	Washer	
46	265741-1	Bearing, Ball	
47	265745-1	Washer, Mylar	
48	887128-4	Table Assembly, Writing (See Figure 6-15) (A-P)	
	127271	Washer	
	1-227070-9	Ring, Retaining	
		-- -- -- -- * -- -- -- -- --	
49	787110	Shaft Assembly, Supply	
50	785718	Flange Assembly, Supply	
51	285764-4	Lens	
52	285764-1	Lens	
53	285765-4	Lamp	
54	685196-2	Lampholder Assembly	
55	685196-1	Lampholder Assembly	
56	2-240731-10	Ring, Retaining, Ext.	
57	9-281506-82	Connector	
58	281506-3	Contact (Sheet 2)	
59	286770	Cover, Panel	
60	793171	Panel Assy., Front L.H. (794938 on Rack Models 2108-8893-XX) (A-P)	
	243898-02	Nut Assembly	
		-- -- -- -- -- * -- -- -- -- --	
61	894284	Plate Assembly, L.H. (See Figure 6-14)	
62	285651-3	Knob	
63	694245	Knob Assembly, Locking	
64	794897-3	Door Assembly (A-P)	
	13-262716-6204	Screw	
	286316-2	Cover (Clear Plastic Strip)	
		-- -- -- -- -- * -- -- -- -- --	

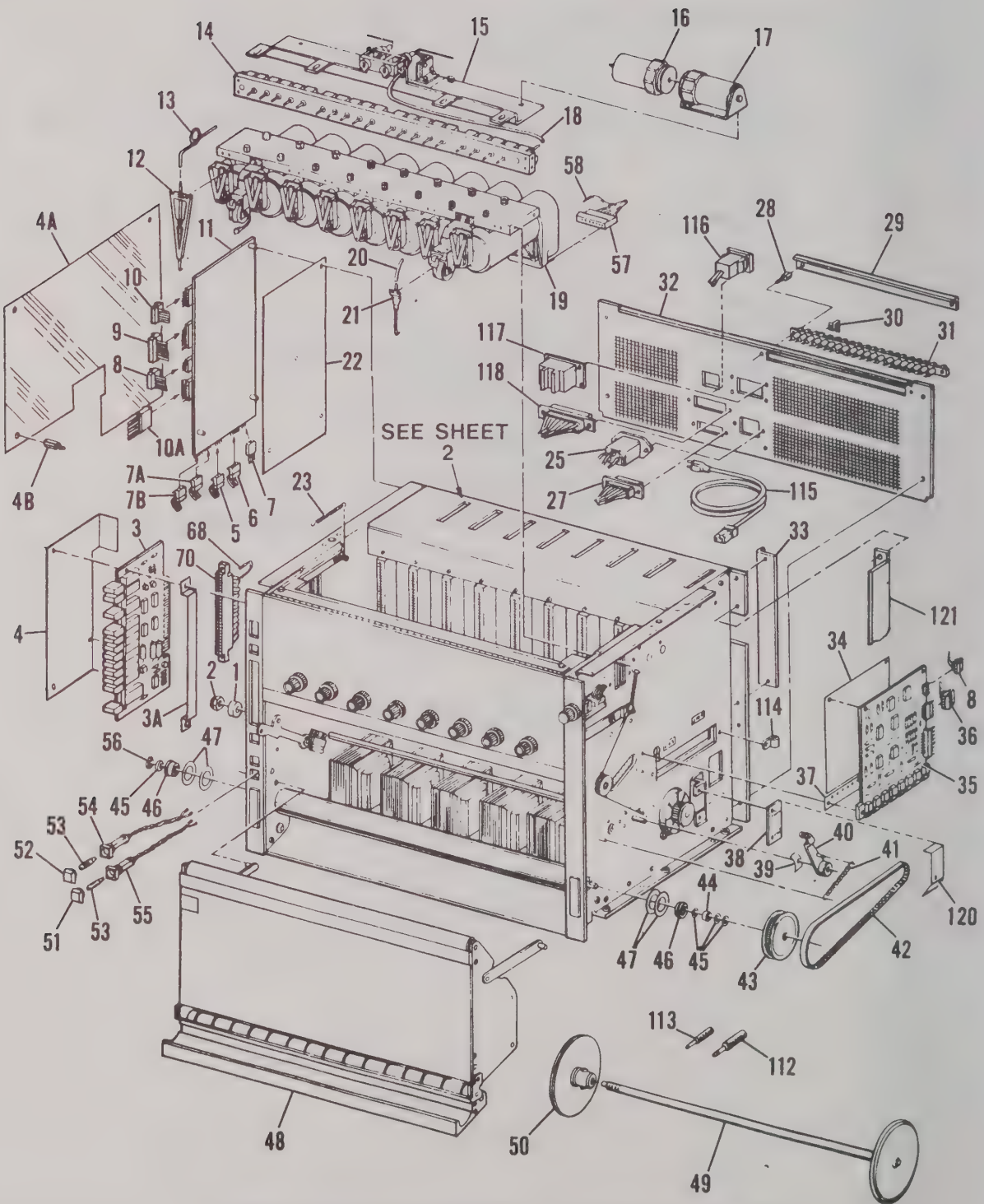
ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
65	387111	Slide	
66	887664	Bracket Assembly, Top (A-P)	
	13-262716-4006	Screw	
		-- -- -- -- -- * -- -- -- -- --	
67	10-286044-103	Resistor, Variable (Pen Position) (A-P)	R101-R108
	1-293279-1	Nut, Plain Hex	
		-- -- -- -- -- * -- -- -- -- --	
68	1-283408-1	Contact	
69	1-283408-2	Contact	
	894717-1	Harness	
69A	281506-1	Contact, Elec.	
69B	9-281501-2	Connector	
70	283420-44	Connector, Drive Amplifier	
70A	284700	Key, Polarizing	
70B	286598	Spring	
70C	265915-1	Terminal Lug (A-P)	
	13-262716-4008	Screw	
		-- -- -- -- -- * -- -- -- -- --	
71	692370	Resistor Assembly	R301
72	894131	Board Assembly, Control (See Figure 6-29)	
73	886220	Board Assembly, Drive Amplifier (See Figure 6-25) (A-P)	
	31-119918-4006	Screw	
	1-120053-201	Lockwasher, Ext.	
		-- -- -- -- -- * -- -- -- -- --	
74	9-270159-2	Connector	
75	270154-1	Contact	
76	0-270156-1	Connector	
77	243225-6	Clamp, Loop (A-P)	
	13-262716-4004	Screw	
	1-118195-304	Washer	
	1-120052-203	Lockwasher, Int. Tooth	
		-- -- -- -- -- * -- -- -- -- --	
78	691288	Jumper Assembly	
79	9-281501-4	Connector	
79A	281502-1	Contact, Elec.	
80	894286	Board Assembly, AC Distribution (A-P)	
	31-119918-4007	Screw	
	31-119918-4003	Screw	
		-- -- -- -- -- * -- -- -- -- --	

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
81	1-280875-13	Spacer, Threaded	
82	494704	Board, P.C. AC Distribution	
83	394755	Support Bar (A-P)	
	31-119918-6210	Screw	
	1-216741-420	Lockwasher, Spring	
		-- -- -- -- -- * -- -- -- -- --	
84	887647	Bracket Assembly, Bottom (A-P)	
	13-262716-4006	Screw	
		-- -- -- -- -- * -- -- -- -- --	
85	894287-1	Plate Assembly, R.H. (See Figure 6-16)	
86	265814-6	Terminal Board (A-P)	
	13-262716-4006	Screw	
		-- -- -- -- -- * -- -- -- -- --	
87	265840-1	Terminal Lug	
88	241513-206	Capacitor	C108
89	794292-27	Wire Assembly (A-P)	
	31-119918-6204	Screw	
	243898-62	Nut Assembly	
		-- -- -- -- -- * -- -- -- -- --	
90	232997-23	Strap, Retaining	
91	783590	Sensor Assembly	
92	743915-10	Arm Assembly, Sensor	
	694405	Stepper Motor Assembly (A-P)	M109
	243898-82	Nut Assembly	
		-- -- -- -- -- * -- -- -- -- --	
93	281502-1	Contact	
94	9-281501-8	Connector	
95	694552	Motor, Stepper	
96	1-232997-23	Strap, Retaining	
97	687103-1	Roll, Drive	
98	696692	Mount, Shock (see note) (A-P)	
	243898-82	Nut Assembly	
		-- -- -- -- -- * -- -- -- -- --	
99	694166	Damper Assembly (See Figure 6-21)	
100	893621	Board Assembly, Vari-Speed (A-P)	
	1-293279-1	Nut Assembly	
		-- -- -- -- -- * -- -- -- -- --	

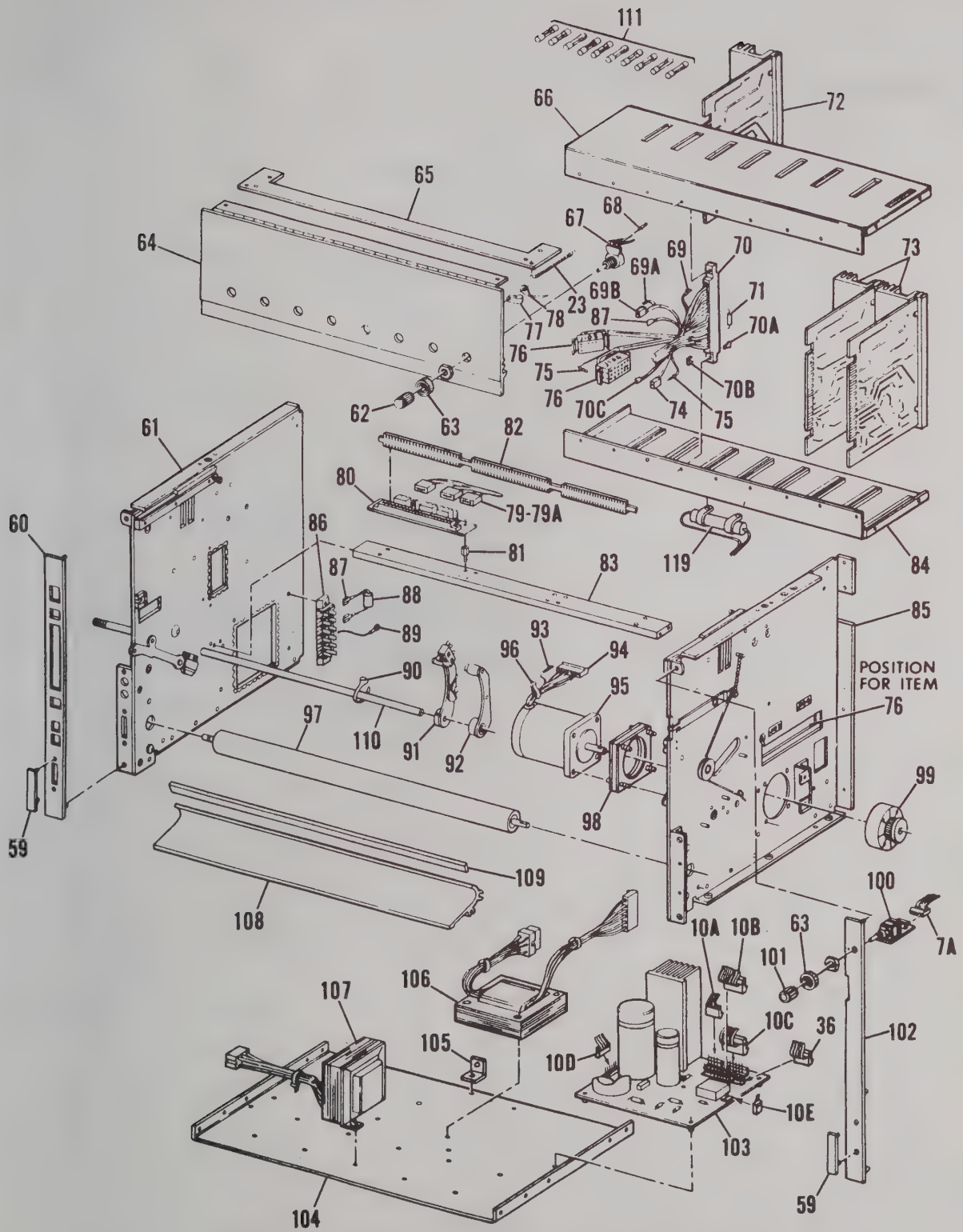
NOTE: New four corner shock mount may require some mounting hole modification.

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
101	285651-16	Knob	
102	794174	Panel Assy., Ft. R.H. (794937 on Rack Models 2108-8893-XX) (A-P)	
	243898-02	Nut Assembly	
		-- -- -- -- -- * -- -- -- -- --	
103	896449	Board Assembly, Power Supply (See Figure 6-32) (A-P)	
	31-119918-6206	Screw	
	1-216741-420	Lockwasher, Spring	
		-- -- -- -- -- * -- -- -- -- --	
104	494712	Chassis, Bottom (A-P)	
	13-262716-8206	Screw	
		-- -- -- -- -- * -- -- -- -- --	
105	286484	Bracket (A-P)	
	13-262716-4004	Screw	
		-- -- -- -- -- * -- -- -- -- --	
106	796690	Transformer Assembly, Control (A-P)	T109
	1-216741-425	Lockwasher, Spring	
	31-119918-8206	Screw	
	290074-72	Spacer	
	31-119918-8220	Screw	
	1-232997-23	Strap, Retaining	
	270153-1	Contact	
	9-270158-56	Connector	
	281502-1	Contact	
	9-281501-6	Connector	
107	296538	Transformer, Control	T109
	694512	Transformer Assembly, Power (A-P)	T101-T108
	31-119918-0208	Screw	
	245244-02	Nut	
		-- -- -- -- -- * -- -- -- -- --	
	9-270158-56	Connector	
	270153-1	Contact	
	232997-23	Strap, Retaining	
	294305	Transformer, Power	

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
108	785701-2	Chute, Paper (A-P)	
	13-262716-8206	Screw -- -- -- -- -- * -- -- -- -- --	
109	267426-2	Paper, Deflector	
110	285357-2	Shaft	
111	116198-4	Fuse 1/8 Amp F-711 (For -00 & -01)	
	116198-10	Fuse 1 Amp F-701, 702 (For-01) F-701 thru F-709 (For-00)	
	116198-11	Fuse 1-1/2 Amp F-709 (For -01)	
	116198-8	Fuse 3/8 Amp F-701, F-702 (For -06)	
	116198-4	Fuse 1/8 Amp F-711 (For -06 & -07)	
	116198-7	Fuse 1/2 Amp F-701, F-702 (For -07) F-709 (For -06)	
	116198-9	Fuse 3/4 Amp F-709 (For 2107-2290-07)	
120	114816-15	Plug	
113	289046	Plug	
114	124804-5	Clamp	
115	291067	Cable Assembly, Power Line Cord	
116	296609-1	Switch, Send Data	
117	296614-2	Switch, Thumbwheel	
118	232886	Connectors, RS232	
119	296539-1	Battery	
120	296315	Insulator, Sensor	
121	296177	Shield, Right Side	
122	11-2123-51	Thermal Annotation Head (See Fig. 6-22) (Not shown)	



2800S RECORDER ASSEMBLY (OVERALL) INK MODEL
FIGURE 6-12



2800S RECORDER ASSEMBLY (OVERALL) INK MODEL
FIGURE 6-13

TABLE 6-1 FUSE TABLE (ITEM 112)

SLOW BLOW FUSE

RECORDER FUSE TABLE				
Fuse Symbol	For-00	For-01	For-06	For-07
F701 thru F708	1A 250V	1A 250V	1/2A 250V	1/2A 250V
F709	1A 250V	1A 250V	3/4A 250V	3/4A 250V
F711W/2 Ink Solenoids	¼A 250V	¼A 250V	¼A 250V	¼A 250V
F711 W/1 Ink Solenoid	1/8A 250V	1/8A 250V	1/8A 250V	1/8A 250V

LINE VOLTAGE

00 = 115V 01 = 100V 06 = 230V 07 = 200V

2800S INK WRITING RECORDER - All Models
L.H. PLATE ASSEMBLY - 894284
FIGURE 6-14

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
1	385619	Bracket, Connecting (A-P)	
	13-262716-4004	Screw	
		-- -- -- -- -- * -- -- -- -- --	
2	1-265849-4	Bracket (A-P)	
	31-119920-6204	Screw	
		-- -- -- -- -- * -- -- -- -- --	
3	385543-2	Guide (A-P)	
	31-126906-405	Screw	
		-- -- -- -- -- * -- -- -- -- --	
4	13-262716-4006	Screw	
5	2-128693-3	Grommet	
6	243623	Spring	
7	243622	Pad, Friction (A-P)	
	13-262716-6204	Screw	
		-- -- -- -- -- * -- -- -- -- --	
8	243611-910	Lever Assembly (A-P)	
	127271	Washer	
	1-220070-9	Ring, Retaining	
		-- -- -- -- -- * -- -- -- -- --	
9	285929	Bracket, L.H. (A-P)	
	31-119920-6204	Screw	
		-- -- -- -- -- * -- -- -- -- --	
10	285599-1	Catch (A-P)	
	13-262716-4005	Screw	
		-- -- -- -- -- * -- -- -- -- --	
	894132	Plate Subassembly	
11	1-123253-1401	Spacer	
12	294254	Rivet	
13	3-129275-105	Nut, Clinch	
14	240161-310	Pin	
15	243440	Bumper	
16	243507-2	Button, Detent (A-P)	
	1-127657-5	Ring, Retaining	
		-- -- -- -- -- * -- -- -- -- --	
17	2-129275-102	Nut, Clinch	
18	494130	Plate, Side L.H.	
19	234485-812	Pin, Straight	
20	265874-4	Pin, Ground	

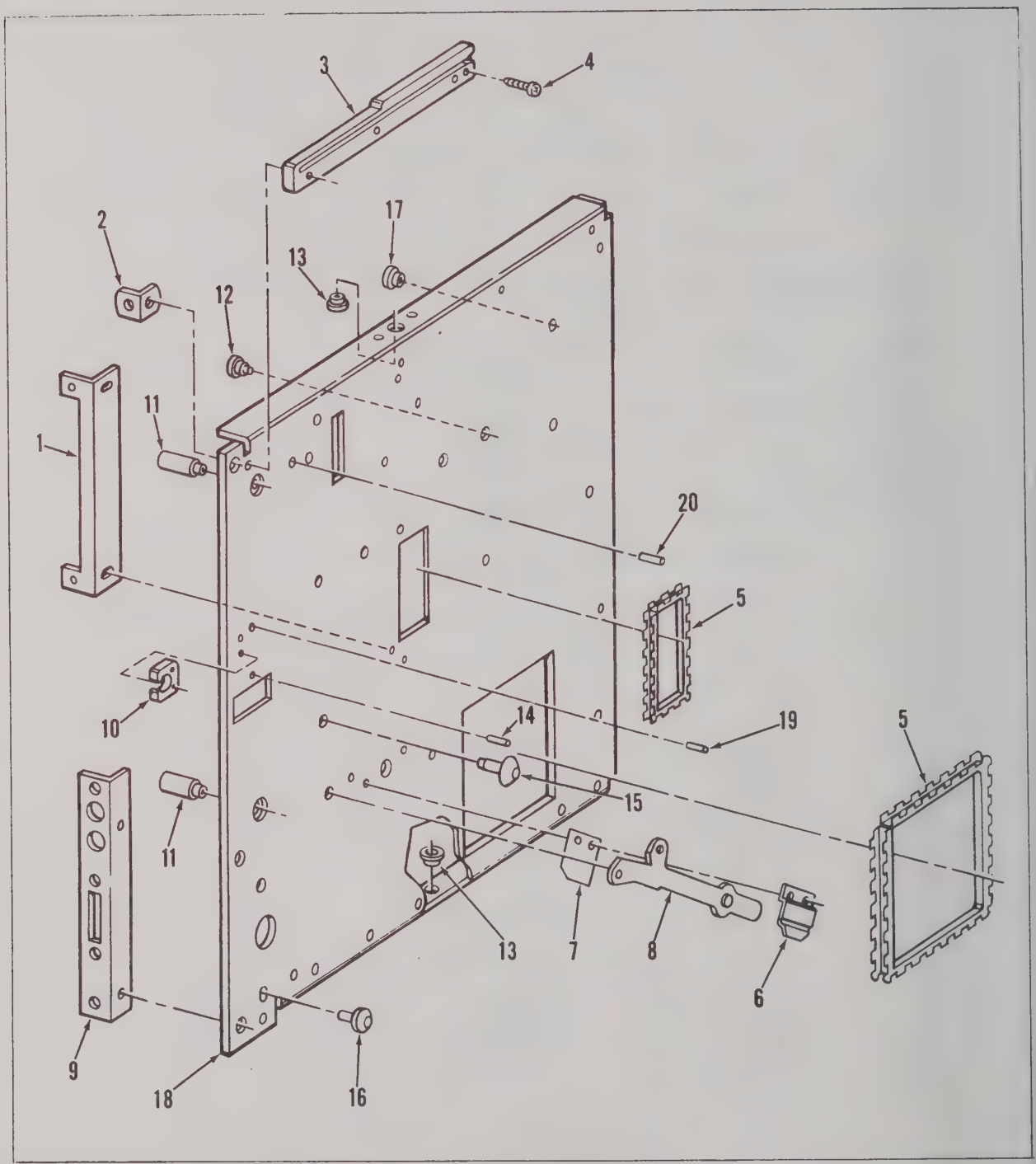


FIGURE 6-14 LEFT HAND SIDE PLATE ASSEMBLY 894284

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
	887128-4 (887128-3)*	Table Assembly, Writing	
1	243855-1	Catch, Friction	
2	243867-1	Packing, Preformed	
3	1-210761-6	Bearing, Ball	
4	343617-1 (343617-2)	Support Assembly - Left (A-P)	
	13-262715-4006	Screw, Mach. - Flat Head	
		-- -- -- -- -- * -- -- -- -- --	
5	395050-1	Roll, pressure	
6	787109	Paper, Release Assembly (A-P)	
	13-262716-6204	Screw, Mach.	
		-- -- -- -- -- * -- -- -- -- --	
7	343616-1 (343616-2)	Support Assembly, R.H. (A-P)	
	13-262715-4006	Screw, Mach. - Flat Head	
8	4-112468-21	Roll Pin	
9	387122	Roll, Pressure	
10	787116-1	Bar, Pull	
11	796863-1 (795053-3)	Bar Assembly, Writing	
12	(695267-1)**	Support Assembly, Top Roller - Right (A-P)	
	(13-262715-4006)**	Screw, Mach. - Flat Head	
		-- -- -- -- -- * -- -- -- -- --	
13	(295265)**	Table, Extender (A-P)	
	(13-119918-6208)**	Screw	
		-- -- -- -- -- * -- -- -- -- --	
14	(695267-2)**	Support Assembly, Top Roller - Left (A-P)	
	(13-262715-4006)**	Screw, Mach. - Flat Head	
		-- -- -- -- -- * -- -- -- -- --	

*Units manufactured before September, 1982 get 887128-3 Table Assy., which uses alternate parts shown in parenthesis, where different.

**Not required on 887128-2.

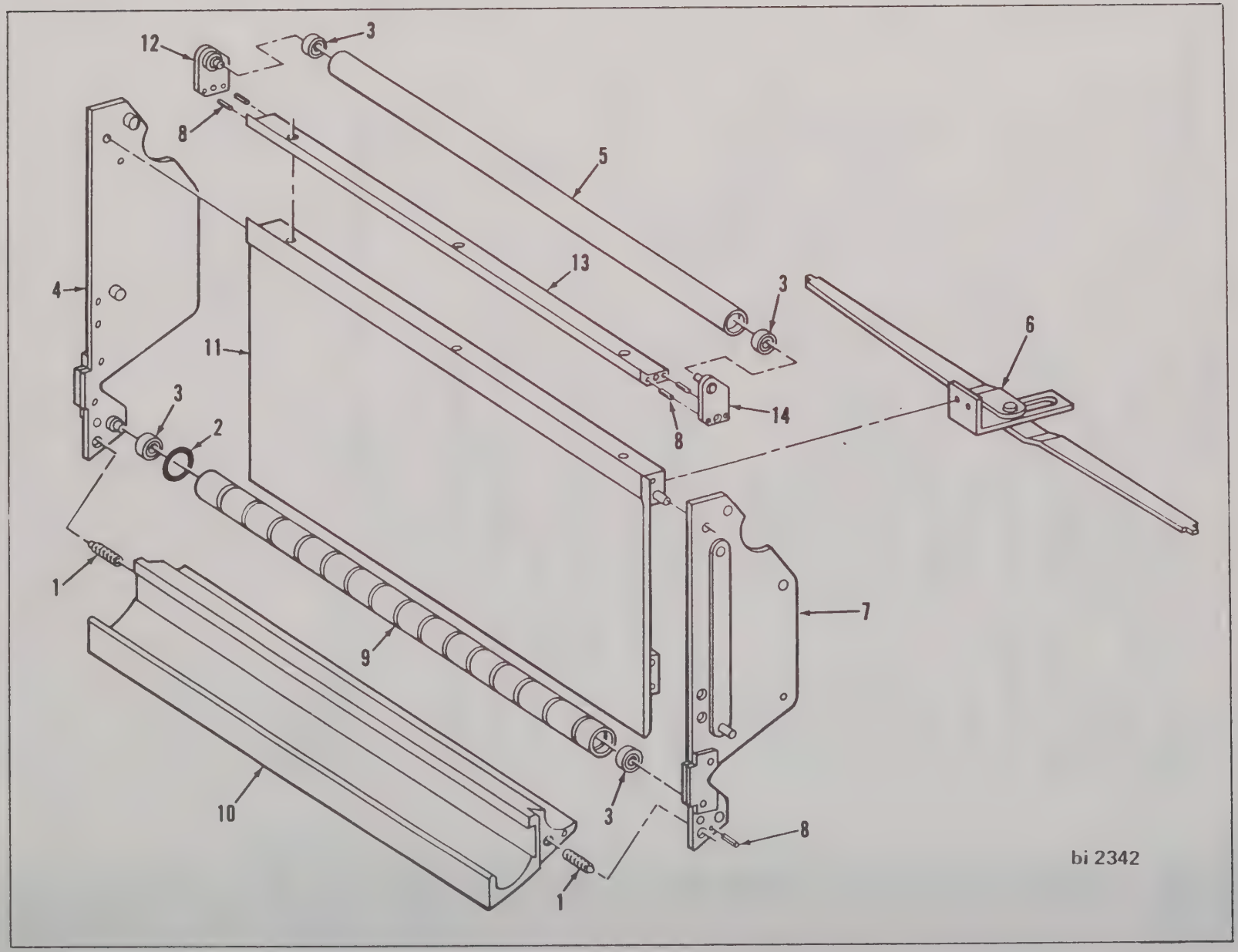


FIGURE 6-15 WRITING TABLE ASSY

2800S INK WRITING RECORDER - All Models
R.H. PLATE ASSEMBLY - 894287-1
FIGURE 6-16

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
	894287-1	Plate Assy., R.H.	
1	385543-1	Guide	
		(A-P)	
	31-126906-406	Screw	
		-- -- -- -- -- * -- -- -- -- --	
2	13-262716-4006	Screw	
3	286130	Bracket, Connecting	
		(A-P)	
	13-262716-6212	Screw	
		-- -- -- -- -- * -- -- -- -- --	
	894138	Plate, Subassy., R.H.	
4	2658741-1	Pin	
5	3-129275-105	Nut, Clinch	
6	243507-2	Button, Detent.	
		(A-P)	
	1-127657-5	Ring, Retaining	
		-- -- -- -- -- * -- -- -- -- --	
7	240161-310	Pin	
8	265874-3	Pin	
9	4-112468-7	Pin, Roll	
10	496583	Plate, Side, R.H.	
11	294213	Bracket, Conn. (Not Used)	
		(A-P)	
	31-119918-6204	Screw (Not Used)	
		-- -- -- -- -- * -- -- -- -- --	
12	694056	Indicator Assy.	
		(A-P)	
	11-125110-1104	Rivet	
	1-227070-3	Ring, Retaining	
		-- -- -- -- -- * -- -- -- -- --	
13	694294	Cable Assy.	
		(A-P)	
	11-125110-1104	Rivet	
	1-2227070-3	Ring, Retaining	
		-- -- -- -- -- * -- -- -- -- --	
14	2-128693-3	Grommet	
15	294342	Bracket, Sensor, Adj.	
		(A-P)	
	31-119918-6204	Screw	
		-- -- -- -- -- * -- -- -- -- --	
16	294341	Bracket, Sensor Mtg.	
		(A-P)	
	31-119918-4003	Screw	
	1-118195-304	Washer, Plain	
		-- -- -- -- -- * -- -- -- -- --	
17	285712	Bracket, R.H.	
		(A-P)	
	31-119920-6204	Screw	
		-- -- -- -- -- * -- -- -- -- --	
18	294343	Bushing	
19	267257	Pulley	
		(A-P)	

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
	31-119918-6208	Screw	
	1-216741-420	Lockwasher, Spring	
	1-118195-305	Washer, Plain	
		-- -- -- -- -- * -- -- -- -- --	
20	665789	Lever Assy., R.H. (A-P)	
	127271	Washer	
	1-227070-9	Ring, Retaining	
		-- -- -- -- -- * -- -- -- -- --	
21	243622	Pad, Friction	
22	243623	Spring (A-P)	
	13-262716-6204	Screw	
		-- -- -- -- -- * -- -- -- -- --	
23	285599	Catch (A-P)	
	13-262716-4008	Screw	
		-- -- -- -- -- * -- -- -- -- --	
24	1-265849-4	Bracket (A-P)	
	31-119920-6204	Screw	
		-- -- -- -- -- * -- -- -- -- --	
25	1-240031-12	Spring	

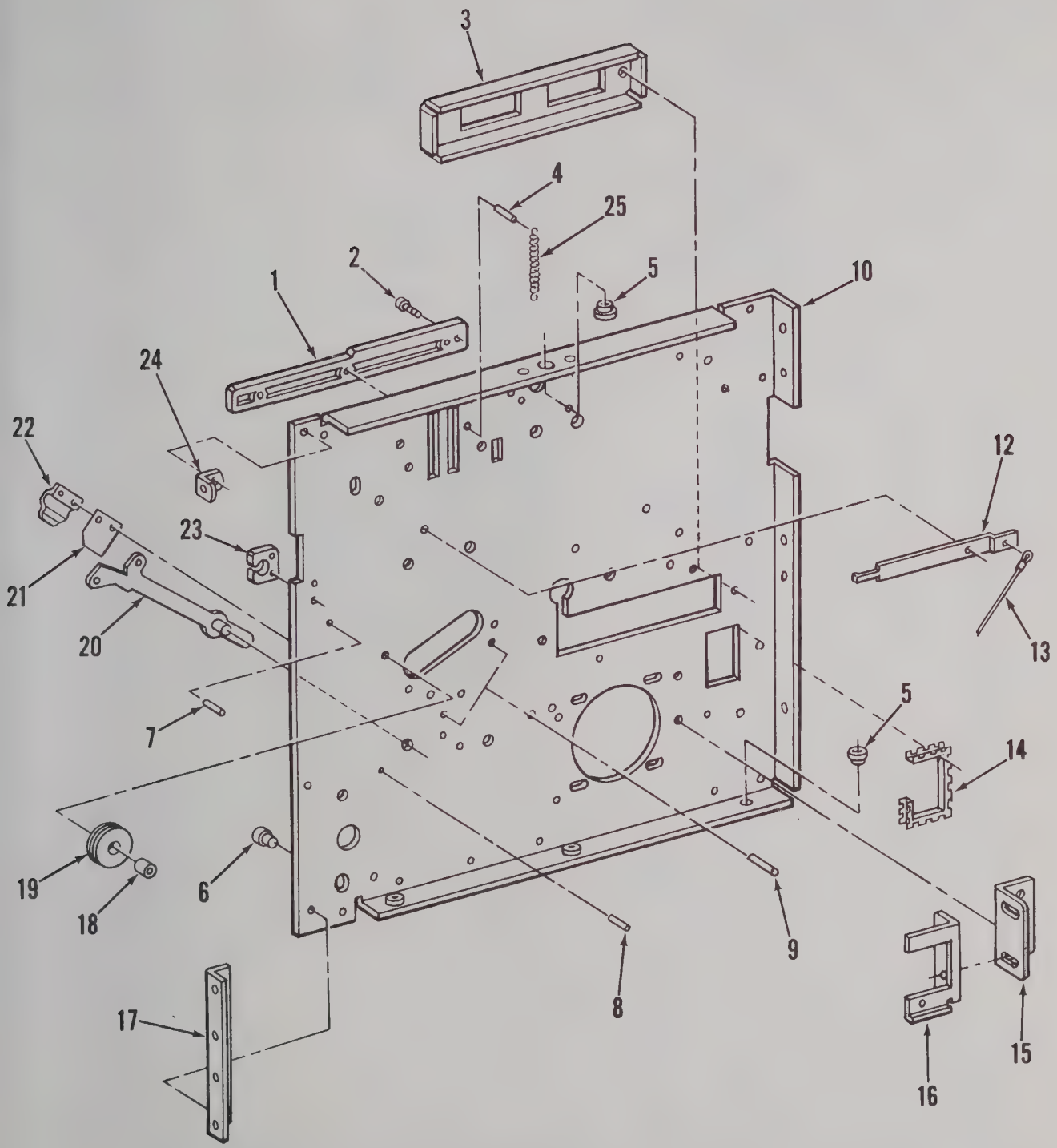


FIGURE 6-16 RIGHT HAND SIDE PLATE ASSEMBLY 894287-1

2800S RECORDER – ALL MODELS
PENMOTOR BAR ASSEMBLY 887749-1†
FIGURE 6-17

ITEM NUMBER	PART NUMBER	DESCRIPTION
1	487708	Mounting Bar
2	287704	Bracket, Event Marker (A-P)
	13-262716-4006	Screw, Self Tapping
		-----*-----
3	887715-1	Event Marker Assembly (A-P)
	31-119920-2604	Screw, Machine
		-----*-----
4	887156	Penmotor Assy
5	285273	Band Anchor
6	684896	Band Clamp
7	265424-09008	Screw, Machine
7A	265424-09008	Screw, Machine
7B	267272-1	Washer, Flat (Not Shown)
8	785269	Drive Arm Assy
9	685270	Drive Band
10	241073-0803	Screw, Set (Pen Adjustment)
11	284993	Pen Pressure Bracket (A-P)
	31-119917-0005	Screws (Pen & Pen Pressure Bracket)
		-----*-----
12	285266-1	Spacer
13	285271	Transition Piece
14	285265	Front Band Clamp
15	686536	Penmotor Support (A-P)
	31-119922-0210	Screw, Machine
	1-216741-430	Lockwasher
		-----*-----

† Penmotor Bar Assy not procurable. Order desired parts from itemized list on this page.

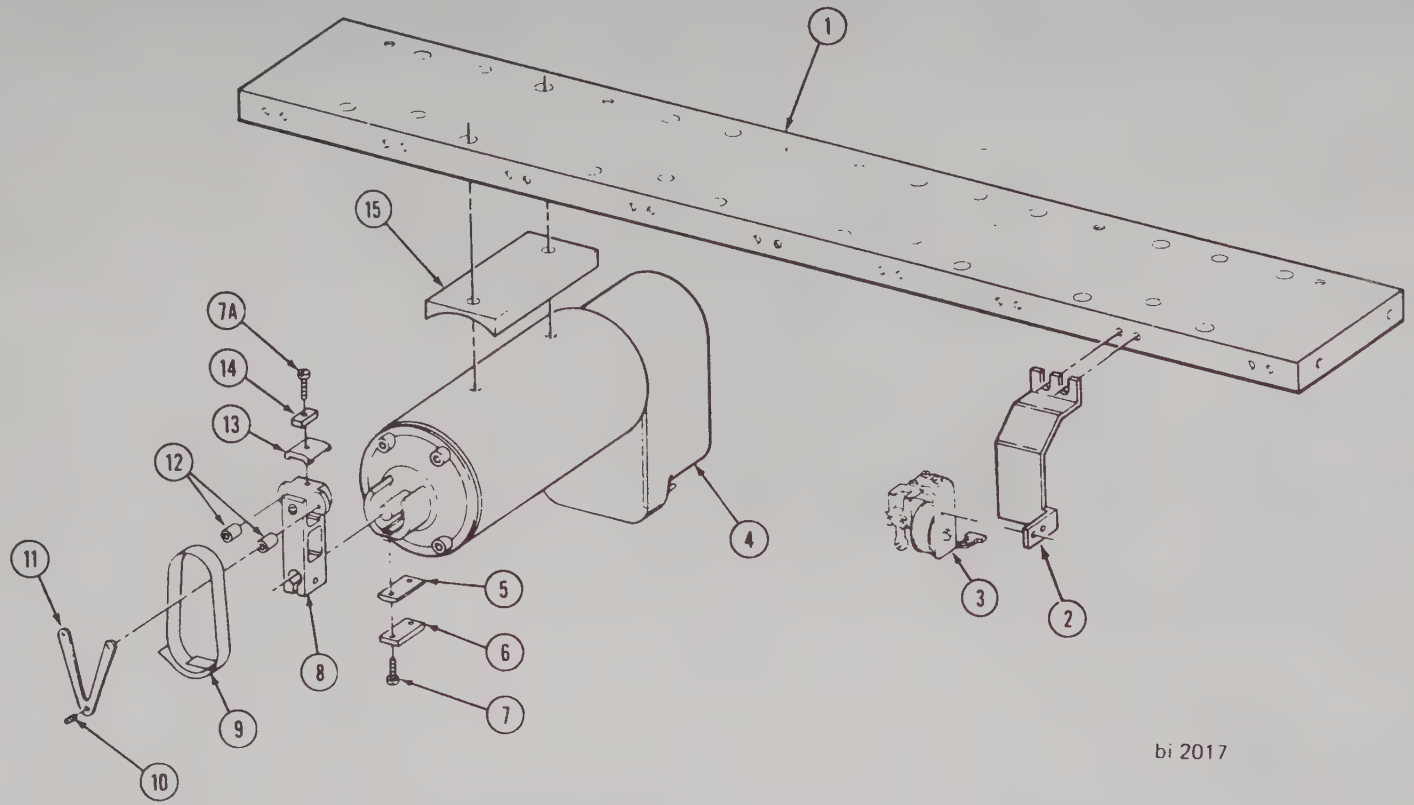


FIGURE 6-17 PENMOTOR BAR ASSEMBLY

2800S SERIES RECORDERS – ALL MODELS
INTERCHANNEL EVENT MARKER KIT 11-2123-37
FIGURE 6-18

ITEM NUMBER	PART NUMBER	DESCRIPTION	SYMBOL NUMBER	USED ON
	11-2123-37	Event Marker, Interchannel		
1	Not Used			
2	*887715	Event Marker Assembly		
3	884661	Harness Assembly		
4	13-262716-4006	Screw, Self-Tapping, Pan Hd., stl 4-40 x 3/8 in.		
5	666587-1	Tube		
6	*11-2873-20	Pen		
7	232997-23	Strap, Retaining		
8	Not Used			
9	Not Used			
10	*287704	Bracket, Event Marker		
11	31-119920-2603	Screw, Mach., Flat Hd., Cross Recessed, 2-56 x 3/16 in.		

*These three parts also available as Gould P/N 690565 Event Marker.

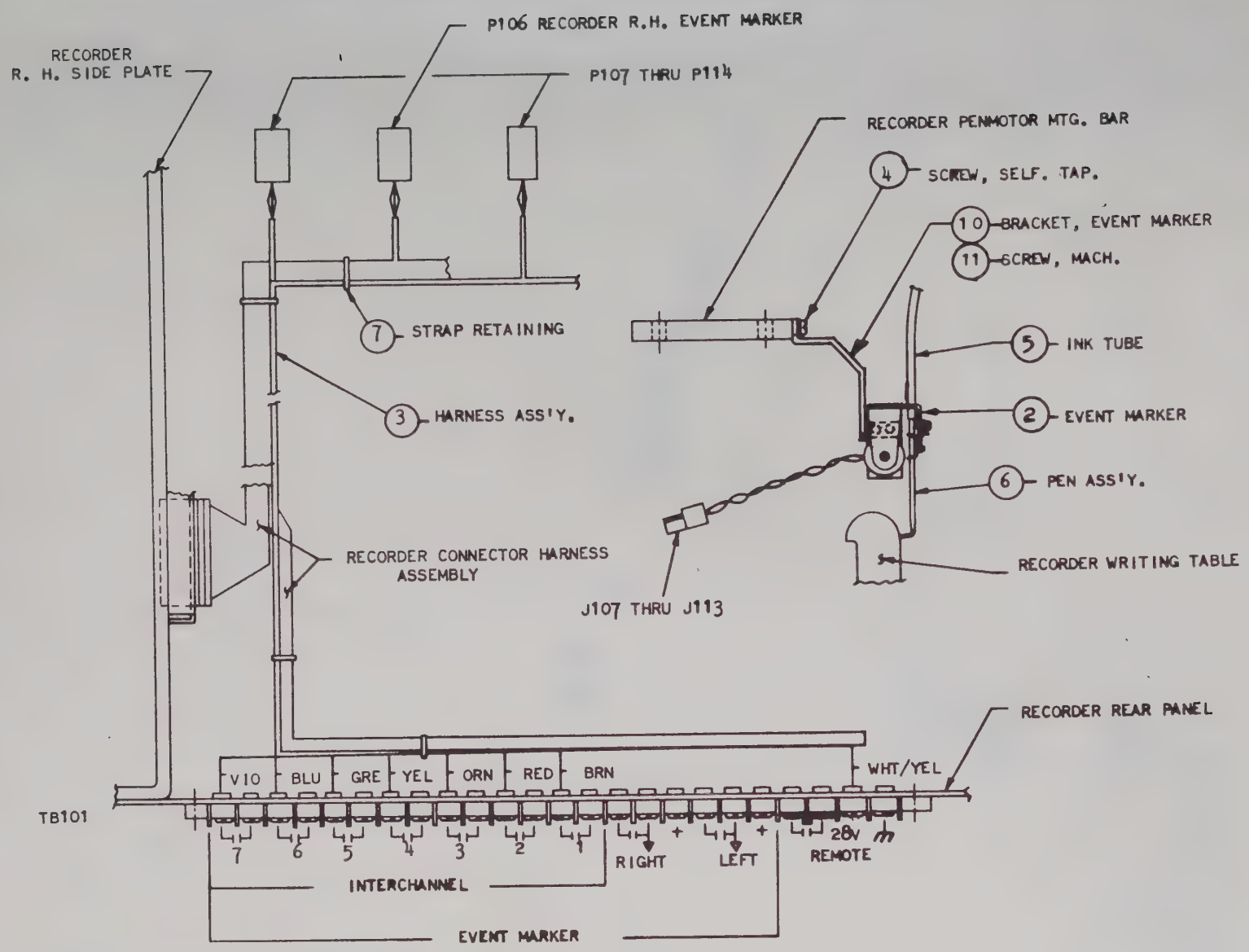


FIGURE 6-18 INTERCHANNEL EVENT MARKER KIT 11-2123-37

2800S INK WRITING SERIES RECORDER – All Models
BRAKE ASS'Y, 694293
FIGURE 6-19

ITEM NUMBER	PART NUMBER	DESCRIPTION
1	685127	Disk Assy
2	0-108400-15	Insulation, Flex Sleeve
3	269291	Spring
4	794054	Arm Sub Assy
5	1-118195-304	Washer
6	0-240731-2	

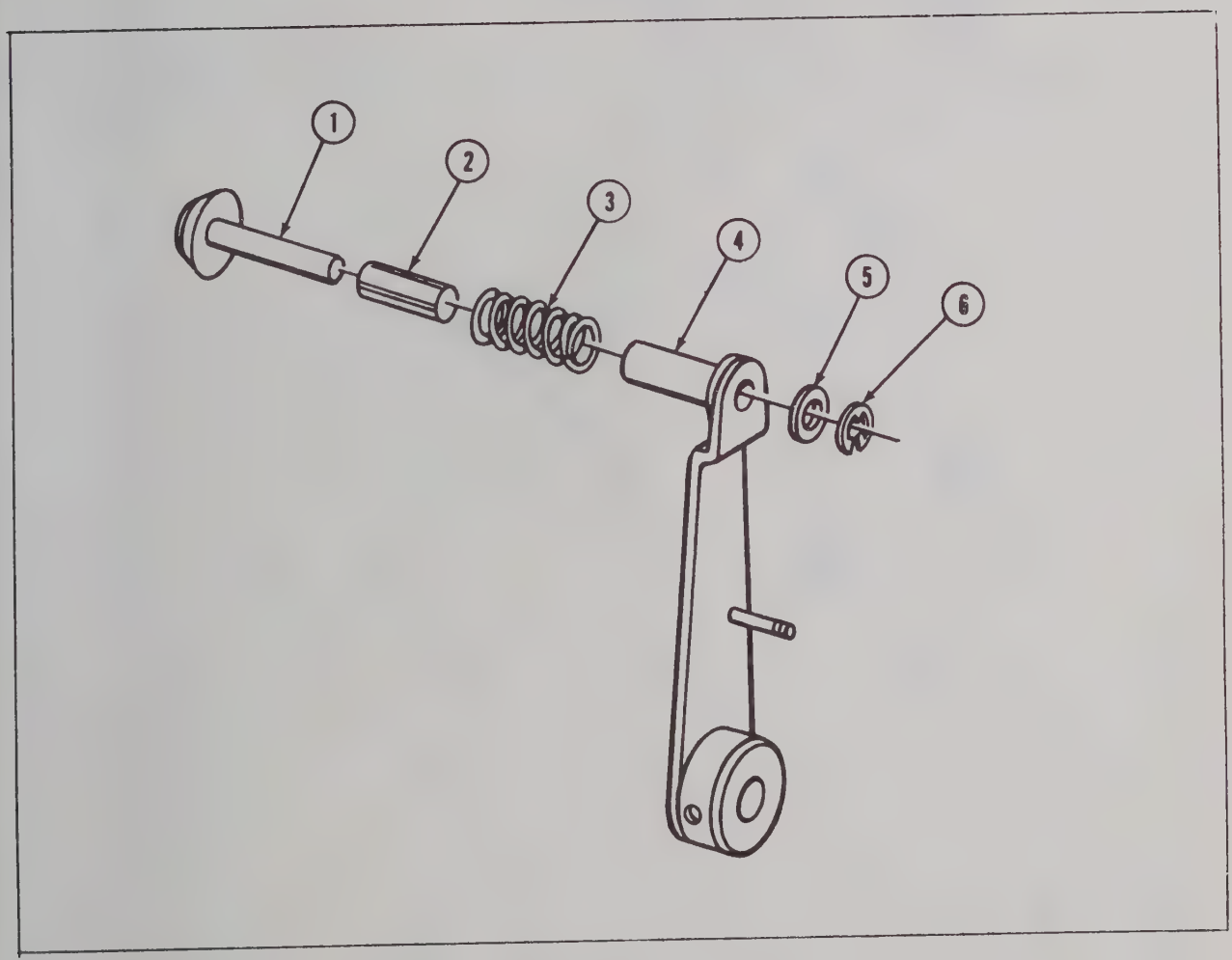


FIGURE 6-19 BRAKE ASSY

2800S RECORDER – ALL MODELS
SENSOR ASSEMBLY
FIGURE 6-20

ITEM NUMBER	PART NUMBER	DESCRIPTION	SYMBOL NUMBER
	783590	Sensor Assembly	
1	286154	Switch Assembly (A-P)	S-102
	13-262716-2606	Screw, Self Tapping	
		------*------	
2	286386	Arm Switch	
3	743915-10	Arm Assy, Sensor	
4	286385	Spring, Torsion	
5	286384	Pin	

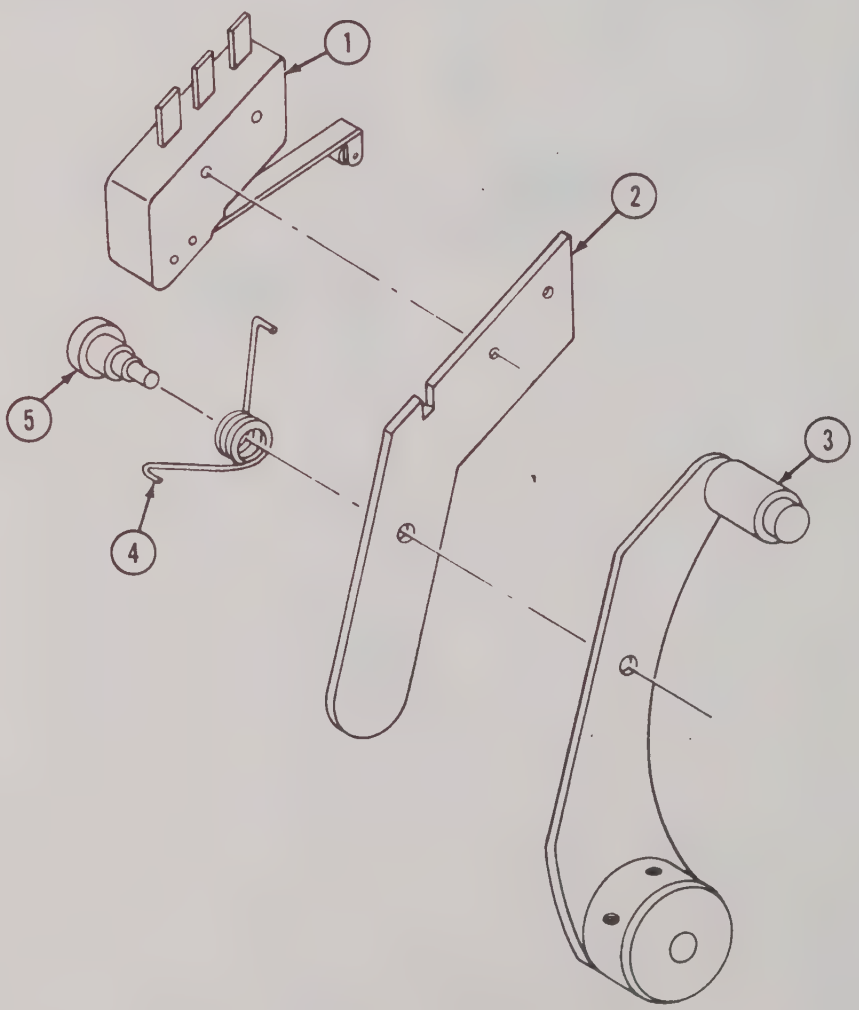


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FIGURE 6-20 PAPER-OUT SENSOR ASSEMBLY

2800S SERIES RECORDER – ALL MODELS
DAMPER ASSY
FIGURE 6-21

ITEM NUMBER	PART NUMBER	DESCRIPTION
	694166	Damper Assy
1	694165	Pulley Assy, Damper
2	240889-2	Bearing, Sleeve
3	294163	Link, Damper - Drive (A-P)
	31-119923-8206	Screw, Set
		------*------
4	294140	Pad, Damper
5	127711-6	Bearing, Sleeve
6	294162	Plate, Cover (A-P)
	31-119920-4006	Screw, Flat Hd.
		------*------

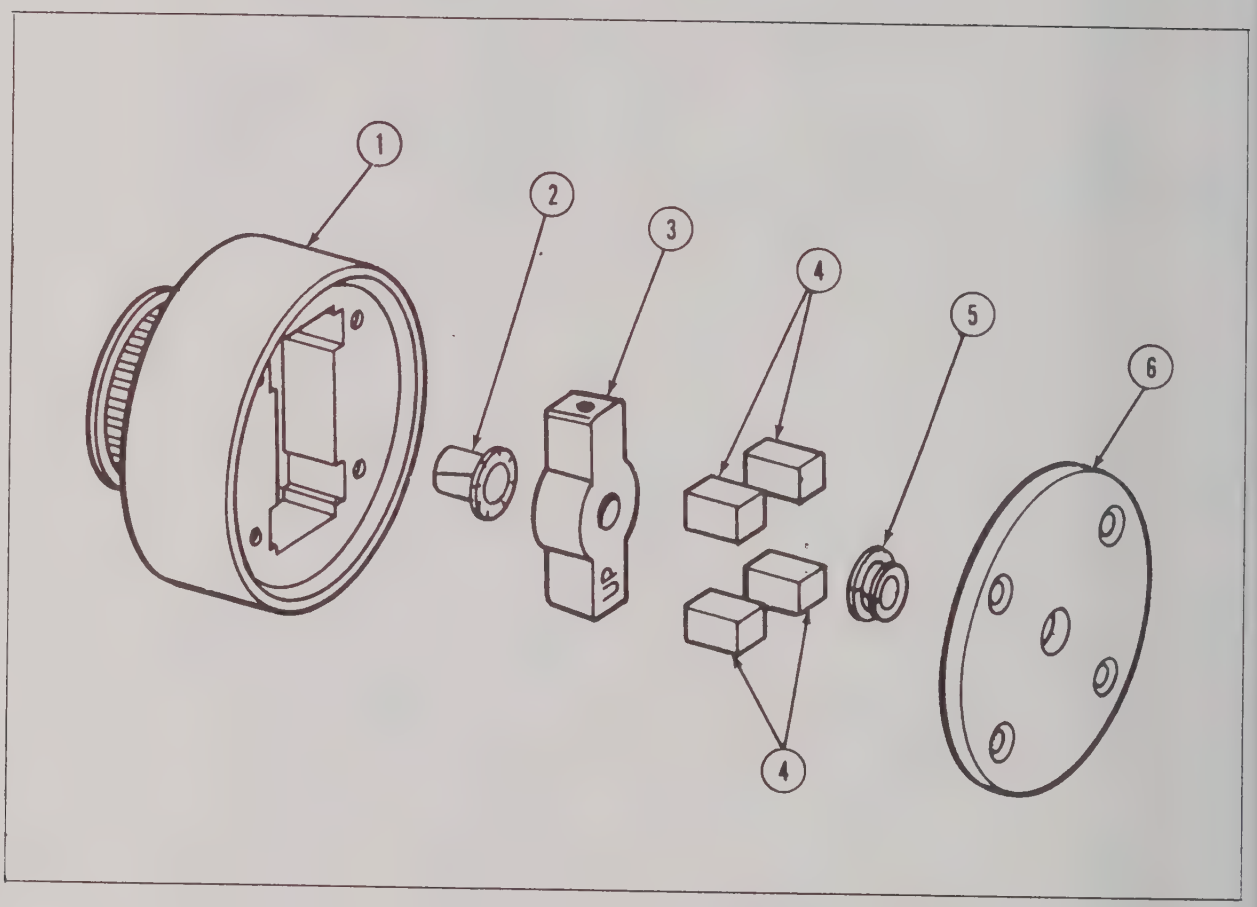


FIGURE 6-21 DAMPER ASSEMBLY - 694166

2000S SERIES RECORDERS - ALL 6 & 8 CHANNEL (OPTIONAL ON 2 & 4 CHANNEL)
THERMAL ANNOTATION HEAD 11-2123-51 (PARTIAL)
FIGURE 6-22

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
	696877	Arm and Head Assembly	
1	896712	Board Assy. Flex PC	
2	296616	Diode	
3	297235	Jumper	
4	296564	Arm	
5	296563	Pin, Pivot	
6	31-119918-2606	Screw	
7	296718	Washer	
8	296719	Bushing	
9	31-119918-2605	Screw	
10	31-119918-4005	Screw	
11	296764	Pin	
12	296720-1	Pin, Pivot	
13	1-264521-15	Spring, Compression	
14	1-227070-3	Ring, Retaining	
15	396566	Arm	
16	1-240031-14	Spring (1-3/8 LG)	
17	1-240031-12	Spring (1.0 LG)	
18	31-119917-0002	Screw, Fillister Head	
19	31-119922-2602	Screw, Socket	
20	1-216741-402	Lockwasher, Spring	
21	1-118195-303	Washer	

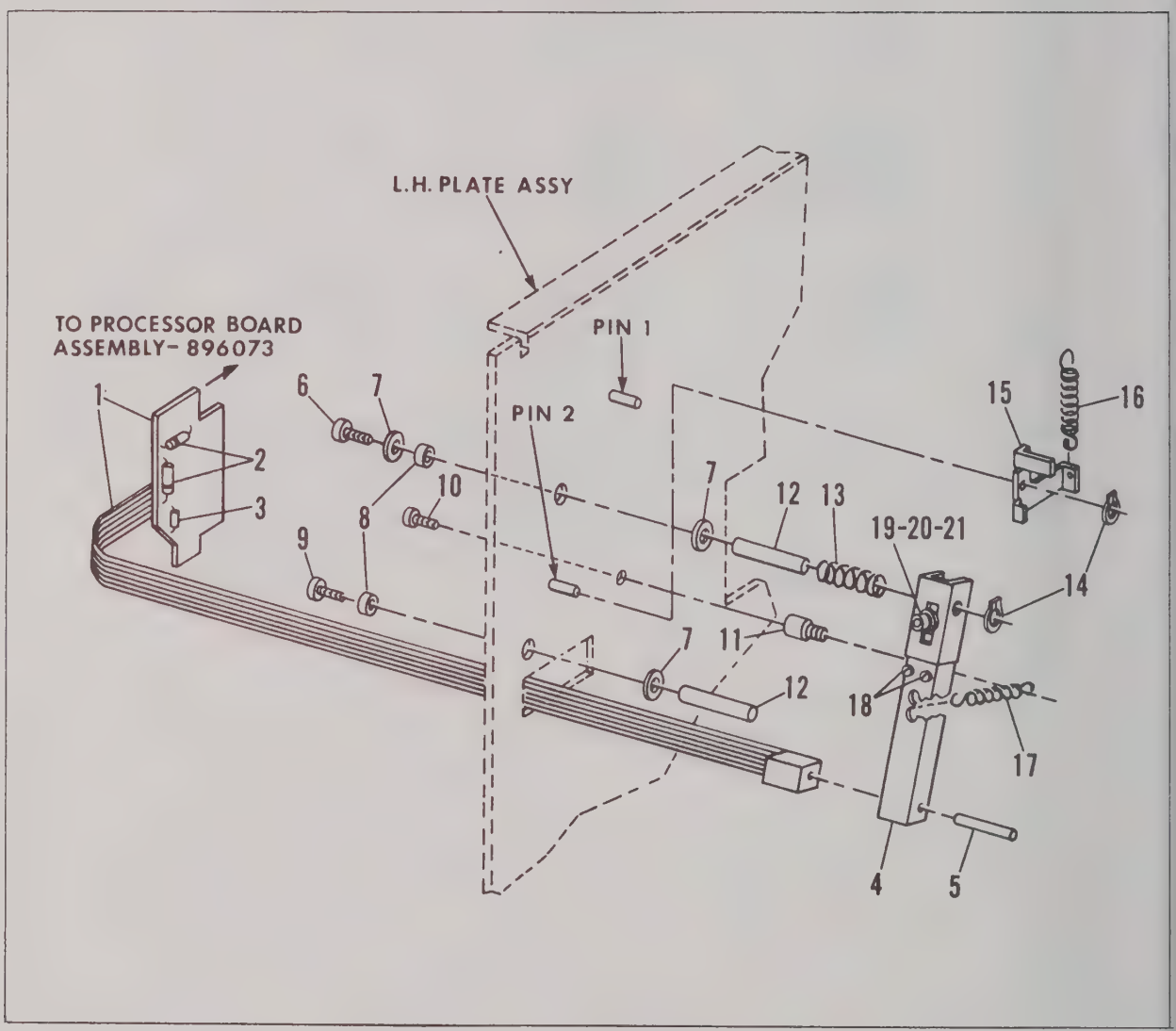
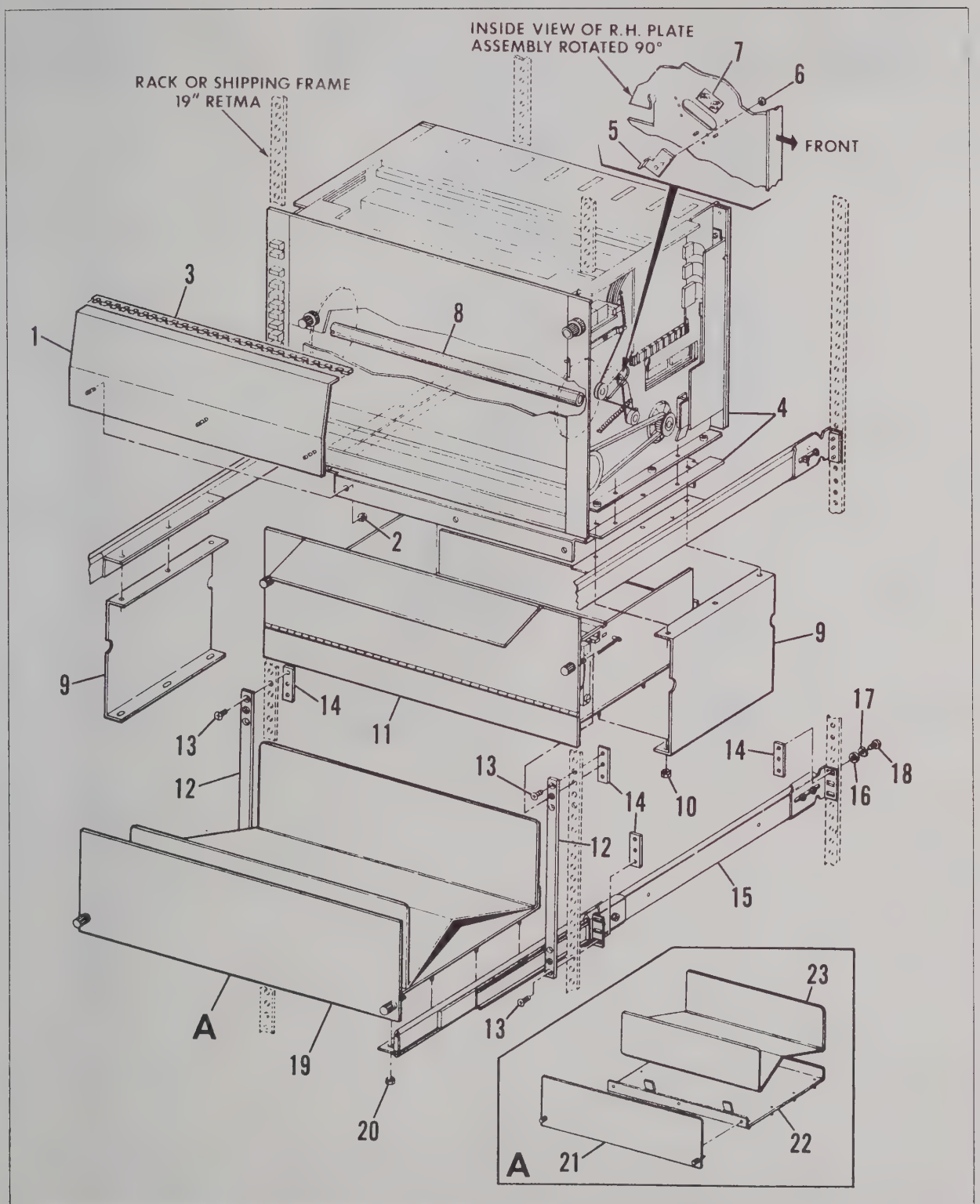


FIGURE 6-22 THERMAL ANNOTATION HEAD 11-2123-51 (PARTIAL)

2000S SERIES RECORDERS - (OPTION) (THERMAL RECORDERS ONLY)
STACK-TO-STACK ASSEMBLY 11-2272-00
FIGURE 6-23

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
	11-2272-00	Kit Assy., Stack to Stack	
1	896807	Cover Assy., Transformer (A-P)	
2	243898-02	Nut Assy., No. 10-32	
		-- -- -- -- -- * -- -- -- -- --	
3	270141	Grommet - Approx. 15"	
4	2007-XXXX-XX	Recorder Assy.	
5	696769	Pressure Defeat Assy. (A-P)	
6	296677-1	Ring, Retaining	
		-- -- -- -- -- * -- -- -- -- --	
7	296823	Label	
8	284775-3	Core, Tube	
9	496861	Bracket, Supply Drawer (A-P)	
10	243898-62	Nut Assy., No. 6-32	
		-- -- -- -- -- * -- -- -- -- --	
11	896816	Drawer Assy., Supply (See Fig. 6-24)	
12	296773	Bar, Spacer (A-P)	
13	31-119920-0208	Screw, Flat HD No. 10-32	
14	287148	Nut Plate	
		-- -- -- -- -- * -- -- -- -- --	
15	296617-4	Slides, Pair (A-P)	
16	1-118195-309	Washer No. 10	
17	1-216741-430	Lockwasher, Spring No. 10	
18	31-119918-0208	Screw, Pan HD No. 10-32	
		-- -- -- -- -- * -- -- -- -- --	
19	896817	Drawer Assy., Take-Up (A-P)	
20	243898-62	Nut Assy., No. 6-32	
		-- -- -- -- -- * -- -- -- -- --	

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
21	896803	Panel Assy., Front, Drawer (A-P)	
	243898-02	Nut Assy.	
		-- -- -- -- -- * -- -- -- -- --	
22	896805	Drawer Subassy.	
23	796988	Cradle, Take-Up	



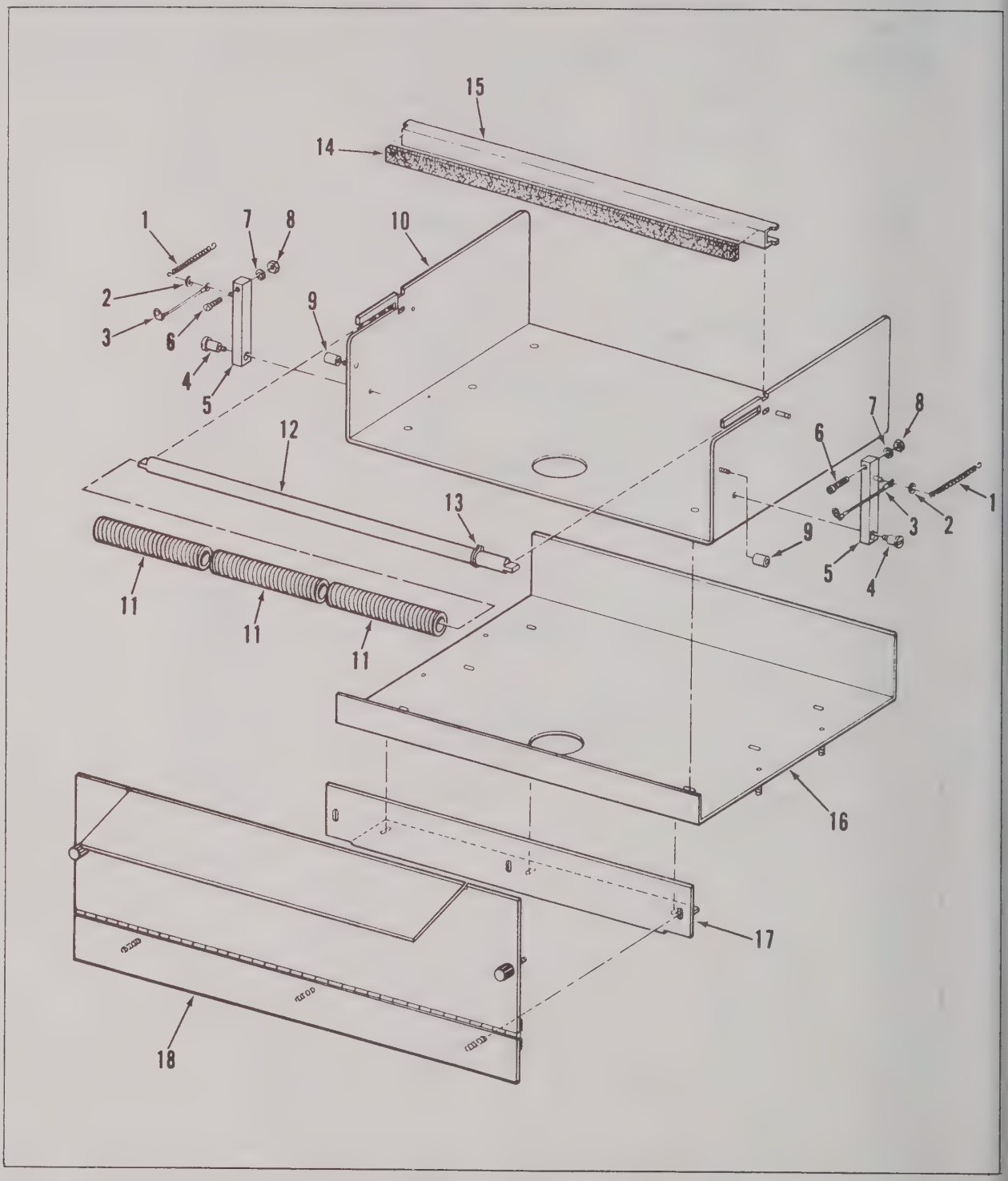
STACK - TO - STACK (OPTION) (11-2272-00) FIGURE 6-23

2000S SERIES RECORDERS - (OPTION) (THERMAL RECORDERS ONLY)
STACK-TO-STACK SUPPLY DRAWER ASSEMBLY 11-2272-00
FIGURE 6-24

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
	896816	Supply Drawer Assembly	
1	240031-15	Spring, Ext.	
2	265672-1	Washer, Flat	
3	696819	Cable Assy. Supply (A-P)	
	243898-40	Nut Assy.	
		-- -- -- -- -- * -- -- -- -- --	
4	296813	Screw, Shoulder	
5	696772	Lever Assy.	
6	31-119922-8212	Screw	
7	1-120052-206	Lockwasher, Int. Tooth	
8	31-129647-82	Nut	
9	4-269579-0	Spacer	
10	896802	Cradle Assy., Supply (A-P)	
	243989-02	Nut Assy.	
		-- -- -- -- -- * -- -- -- -- --	
11	296873	Roller, Threaded	
12	296653	Bar, Brake	
13	127657-9	Ring, Retaining	
	796812	Pad Assy., Mount	
14	245383-5	Pad (A-P)	
	280760-2	Tape, Double Coated	
15	396777	Holder, Brake Pad	
16	896806	Drawer, Supply-Subassy. (A-P)	
	243898-02	Nut Assy.	
		-- -- -- -- -- * -- -- -- -- --	

2000S SERIES RECORDERS - (OPTION) (THERMAL RECORDERS ONLY)
STACK-TO-STACK SUPPLY DRAWER ASSEMBLY 11-2272-00
FIGURE 6-24

ITEM NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6	REMARKS
17	496809	Bracket, Mounting Drawer (A-P)	
	243898-02	Nut Assy.	
		-- -- -- -- -- * -- -- -- -- --	
18	896808	Front Panel Assy.	



STACK-TO-STACK SUPPLY DRAWER (OPTION) (11-2272-00)
FIGURE 6-24

2000S SERIES RECORDERS-ALL MODELS
BOARD ASSY., DRIVE AMPLIFIER 886220 (SCHEMATIC 292273)
FIGURE 6-25

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
C201	10-125904-223	Capacitor, .022 μfd, 100V
C202	10-247116-102	Capacitor, .001 μfd, 100V
C203, C204	10-247116-102	Capacitor, .001 μfd, 100V
C205	240352-501	Capacitor, 500 pfd, 1000V
C206	10-247116-103	Capacitor, .01 μfd, 100V
C207	240352-501	Capacitor, 500 pfd, 1000V
C208	262585-106	Capacitor, 10 μfd, 20V
C209	10-247116-103	Capacitor, .01 μfd, 100V
C210, C211	10-247116-102	Capacitor, .001 μfd, 100V
C212	240352-202	Capacitor, .002 μfd, 1000V
C213	10-125904-503	Capacitor, .05 μfd, 100V
C214	10-125904-223	Capacitor, .022 μfd, 100V
C215	281509-477	Capacitor, 470 μfd, 35V
C216	262585-106	Capacitor, 10 μfd, 20V
C217	281509-477	Capacitor, 470 μfd, 35V
C218	262585-106	Capacitor, 10 μfd, 20V
C219 thru C222	286010-108	Capacitor, 1000 μfd, 50V
C223*	288755-104	Capacitor, .1 μfd, 50V
C224**	240352-101	Capacitor, 100 pfd
CR201, CR202	263727	Diode, 1N961B
CR203 thru CR208	270508	Diode, 1N4454
CR209, CR210	286018-1	Diode, MDA-101
CR211	269256-7	Diode, 1N4007
CR212	270508	Diode, 1N4454
Q201	281703-2	Transistor, 2N4403
Q202	281702-2	Transistor, 2N4401
Q203 thru Q205	286141	Transistor, 2N3904
Q206	1-230057-3	Transistor, 2N4923
Q207	1-286145-1	Transistor, 2N5982 (A-P)
	12-119918-4006	Screw
		-- -- -- -- -- * -- -- -- -- --
Q208	1-230058-3	Transistor, 2N4920
Q209	1-286147-1	Transistor, 2N5985 (A-P)
	12-119918-4006	Screw
		-- -- -- -- -- * -- -- -- -- --

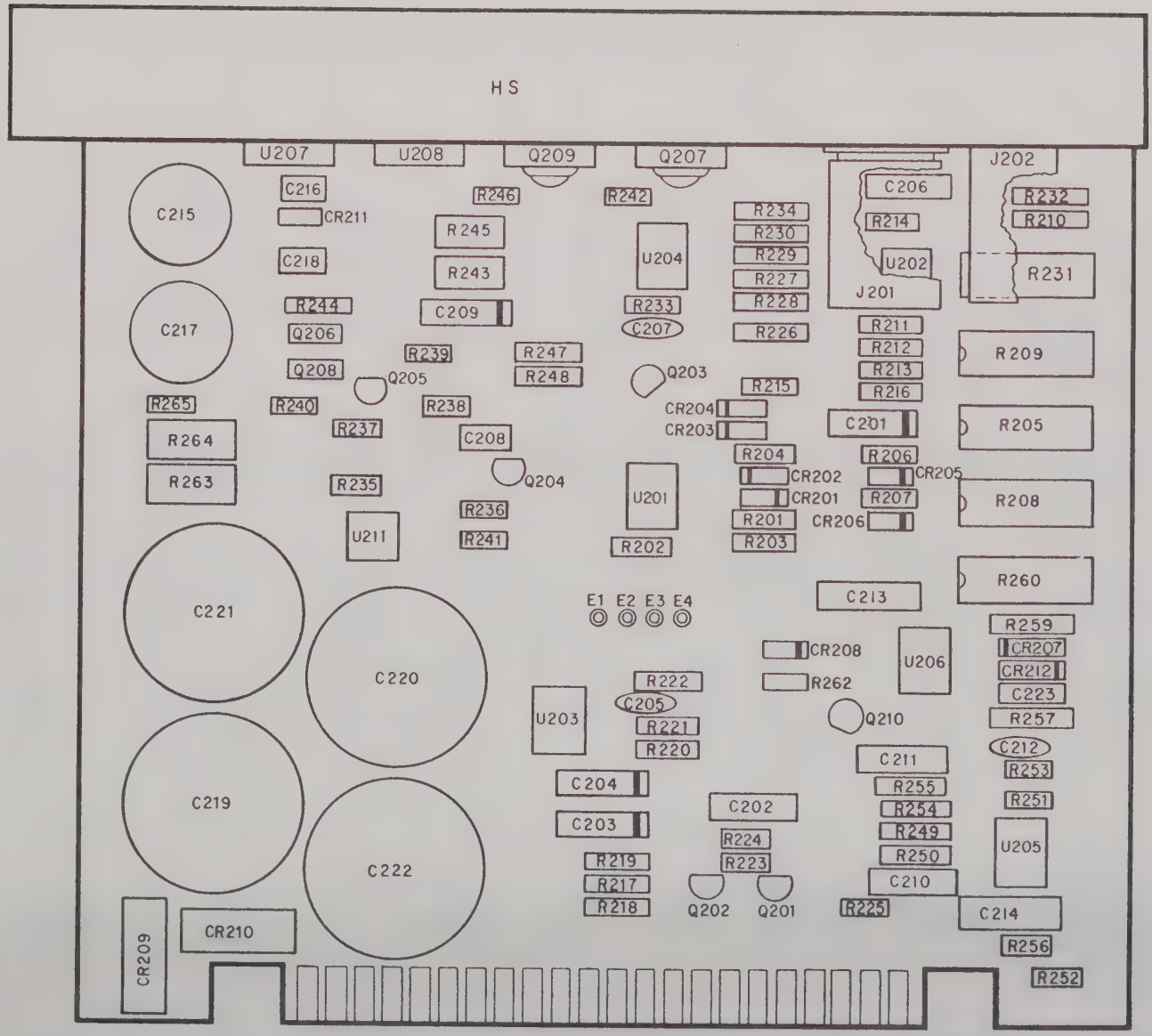
*Used only in 80mm applications.
**Not in all units.

2000S SERIES RECORDERS-ALL MODELS
BOARD ASSY., DRIVE AMPLIFIER 886220 (SCHEMATIC 292273)
FIGURE 6-25

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
Q210	281857-2	Transistor, 2N5033
R201	1-281851-30002	Resistor, 300 Kohms
R202	1-281851-10002	Resistor, 100 Kohms
R203	1-281851-43201	Resistor, 43.2 Kohms
R204	1-281851-10002	Resistor, 100 Kohms
R205	282299-103	Resistor, 10 Kohms
R206, R207	1-281851-69000	Resistor, 6.9 Kohms
R208	282299-103	Resistor, 10 Kohms
R209	282299-202	Resistor, 2 Kohms
R210	1-281851-200R0	Resistor, 200 ohms
R211	1-281851-10002	Resistor, 100 Kohms
R212, R213	1-281851-10001	Resistor, 10 Kohms
R214	1-281851-16601	Resistor, 16.6 Kohms
R215, R216	1-281851-10000	Resistor, 1 Kohms
R217, R218	1-281851-80000	Resistor, 8 Kohms
R219	1-281851-72001	Resistor, 7.2 Kohms
R220	1-281851-40000	Resistor, 4 Kohms
R221	1-281851-80001	Resistor, 80 Kohms
R222	1-281851-40001	Resistor, 40 Kohms
R223, R224	5-241111-622	Resistor, 6.2 Kohms
R225	5-241111-392	Resistor, 3.9 Kohms
R226, R227	1-281851-50001	Resistor, 50 Kohms
R228	1-281851-10002	Resistor, 100 Kohms
R229	1-281851-60001	Resistor, 60 Kohms
R230	1-281851-60000	Resistor, 6 Kohms
R231	282299-502	Resistor, 5 Kohms
R232	1-281851-500R0	Resistor, 500 ohms
R233	1-281851-10003	Resistor, 1 Megohms
R234	1-281851-26501	Resistor, 26.5 Kohms
R235	5-241111-104	Resistor, 100 Kohms
R236	5-241111-203	Resistor, 20 Kohms
R237	5-241111-822	Resistor, 8.2 Kohms
R238	5-241111-102	Resistor, 1 Kohm
R239, R240	5-241111-202	Resistor, 2 Kohms
R241	5-241111-391	Resistor, 390 ohms
R242	5-241111-102	Resistor, 1 Kohms
R243	5-286587-181	Resistor, 180 ohms
R244	5-283654-220	Resistor, 22 ohms
R245	5-286587-181	Resistor, 180 ohms
R246	5-241111-102	Resistor, 1 Kohms
R247	1-281851-20001	Resistor, 20 Kohms
R248	1-281851-500R0	Resistor, 500 ohms
R249, R250	1-281851-80000	Resistor, 8 Kohms
R251	5-241111-104	Resistor, 100 Kohms
R252, R253	5-241111-103	Resistor, 10 Kohms

2000S SERIES RECORDERS-ALL MODELS
BOARD ASSY., DRIVE AMPLIFIER 886220 (SCHEMATIC 292273)
FIGURE 6-25

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
R254	1-281851-16001	Resistor, 16 Kohms
R255	1-281851-50000	Resistor, 5 Kohms
R256	5-241111-101	Resistor, 100 ohms
R257	1-281851-20001	Resistor, 20 Kohms
R258	Not Used	
R259	1-281851-40001	Resistor, 40 Kohms
R260	282299-103	Resistor, 10 Kohms
R261	Not Used	
R262	5-241111-104	Resistor, 100 Kohms
R263, R264	5-130340-2R0	Resistor, 2 ohms
R265	5-241111-822	Resistor, 8.2 Kohms
U201 thru U204	280863-3	I.C., 741C
U205	269941-2	I.C., 1439P1
U206	280863-3	I.C., 741C
U207	285461	Voltage Regulator, MC7815 (A-P)
	12-119918-4005	Screw
		-- -- -- -- -- * -- -- -- -- --
U208	285778	Voltage Regulator, MC7915 (A-P)
	12-119918-4005	Screw
		-- -- -- -- -- * -- -- -- -- --
U209, U210	Not Used	
U211	285589	Isolator, LED, 4N28
HS	686391	Heat Sink (A-P)
	31-119918-4005	Screw
	1-118195-304	Washer
	1-216741-411	Lockwasher
		-- -- -- -- -- * -- -- -- -- --
------	685187	Jack Assembly
J201	285315	Jack
J202	289045	Jack (A-P)
	1-120052-211	Lockwasher
		-- -- -- -- -- * -- -- -- -- --
E1 thru E4	265763-3	Contact



DRIVE AMPLIFIER BOARD ASSEMBLY - 886220
FIGURE 6-25

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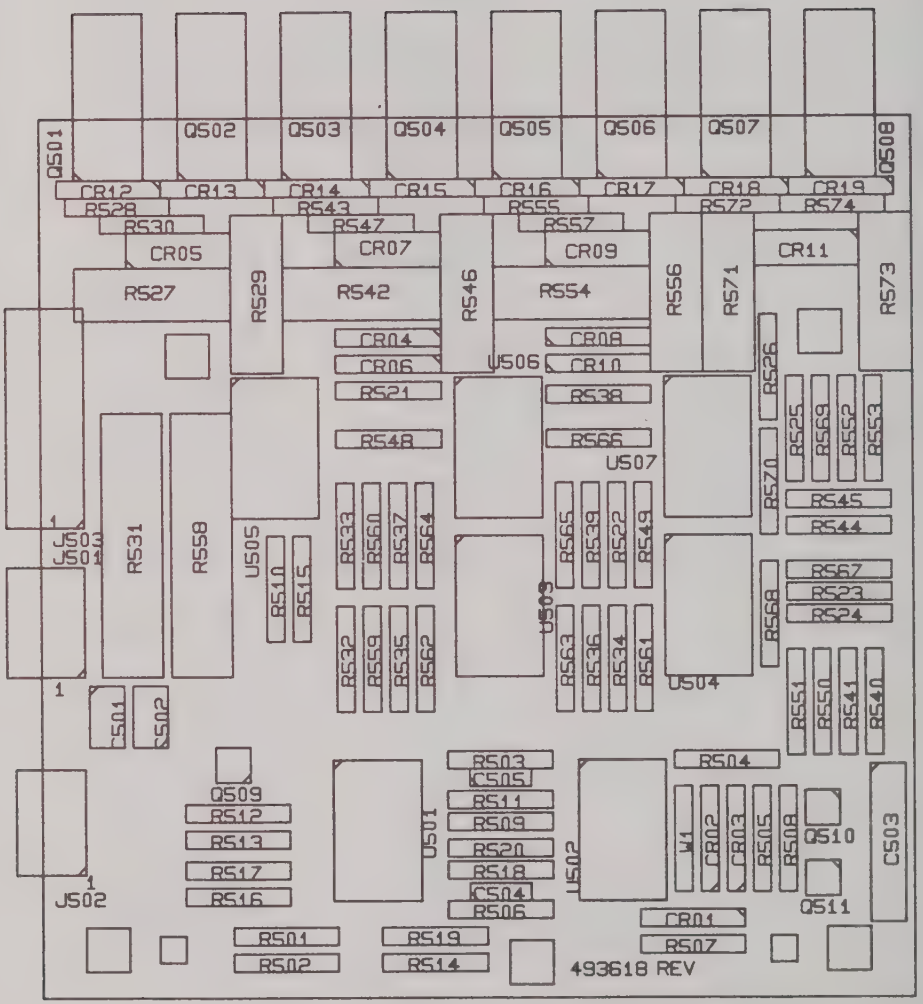
BOARD ASSY., SWITCHING AMPLIFIER 893618
FIGURE 6-26

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
C501, C502	283943-476	Capacitor, 47 μfd @ 20V
C503	10-125904-602	Capacitor, .006 μfd @ 25V
C504, C505	240352-101	Capacitor, 100 pfd @ 1000V
CR01 thru CR04	289662	Diode, 1N914
CR05	284425-1	Diode, 1N5550
CR06	289662	Diode, 1N914
CR07	284425-1	Diode, 1N5550
CR08	289662	Diode, 1N914
CR09	284425-1	Diode, 1N5550
CR10	289662	Diode, 1N914
CR11	284425-1	Diode, 1N5550
CR12 thru CR19	269256-7	Diode, 1N4007
J501	294063-4	Connector
J502	294063-6	Connector
J503	294063-8	Connector
Q501 thru Q508	294066-3	Transistor, 2N6107
Q509	286143	Transistor, 2N3906
Q510, Q511	286141	Transistor, 2N3904
R501	5-241111-512	Resistor, 5.1 Kohms
R502	5-241111-103	Resistor, 10 Kohms
R503	5-241111-272	Resistor, 2.7 Kohms
R504	5-241111-103	Resistor, 10 Kohms
R505	5-241111-102	Resistor, 1Kohm
R506	5-241111-183	Resistor, 18 Kohms
R507	5-241111-274	Resistor, 270 Kohms
R508	5-241111-102	Resistor, 1 Kohms
R509	5-241111-123	Resistor, 12 Kohms
R510	5-241111-512	Resistor, 5.1 Kohms
R511	5-241111-225	Resistor, 2 Megohms
R512, R513	5-241111-912	Resistor, 9.1 Kohms
R514	5-241111-202	Resistor, 2 Kohms
R515	5-241111-512	Resistor, 5.1 Kohms
R516, R517	5-241111-912	Resistor, 9.1 Kohms
R518	5-241111-225	Resistor, 2.2 Megohms
R519	5-241111-202	Resistor, 2 Kohms
R520	5-241111-123	Resistor, 12 Kohms

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
R521	5-241111-152	Resistor, 1.5 Kohms
R522	5-241111-123	Resistor, 12 Kohms
R523	5-241111-102	Resistor, 1 Kohms
R524	5-241111-123	Resistor, 12 Kohms
R525	5-241111-103	Resistor, 10 Kohms
R526	5-241111-512	Resistor, 5.1 Kohms
R527	5-241111-331	Resistor, 330 ohms, 1W, 5%
R528	5-241111-471	Resistor, 470 ohms
R529	5-241111-331	Resistor, 330 ohms, 1W, 5%
R530	5-241111-471	Resistor, 5.1 Kohms
R531	1-294064-00R5	Resistor, .5 ohms, 5W, 1%
R532	5-241111-512	Resistor, 5.1 Kohms
R533	5-241111-272	Resistor, 2.7 Kohms
R534	5-241111-182	Resistor, 1.8 Kohms
R535	5-241111-123	Resistor, 12 Kohms
R536	5-241111-512	Resistor, 5.1 Kohms
R537	5-241111-272	Resistor, 2.7 Kohms
R538	5-241111-152	Resistor, 1.5 Kohms
R539	5-241111-123	Resistor, 12 Kohms
R540	5-241111-122	Resistor, 1.2 Kohms
R541	5-241111-123	Resistor, 12 Kohms
R542	5-115558-331	Resistor, 330 ohms, 1W, 5%
R543	5-241111-471	Resistor, 470 ohms
R544	5-241111-103	Resistor, 10 Kohms
R545	5-241111-512	Resistor, 5.1 Kohms
R546	5-115558-331	Resistor, 330 ohms, 1W, 5%
R547	5-241111-471	Resistor, 470 ohms
R548	5-241111-152	Resistor 1.5 Kohms
R549	5-241111-123	Resistor, 12 Kohms
R550	5-241111-102	Resistor, 1 Kohms
R551	5-241111-123	Resistor, 12 Kohms
R552	5-241111-103	Resistor, 10 Kohms
R553	5-241111-512	Resistor, 5.1 Kohms
R554	5-115558-331	Resistor, 330 ohms, 1W, 5%
R555	5-241111-471	Resistor, 470 ohms
R556	5-115558-331	Resistor, 330 ohms, 1W, 5%
R557	5-241111-471	Resistor, 470 ohms
R558	1-294064-00R5	Resistor, .5 ohms, 5W, 1%
R559	5-241111-512	Resistor, 5.1 Kohms
R560	5-241111-272	Resistor, 2.7 Kohms

BOARD ASSY., SWITCHING AMPLIFIER 893618
FIGURE 6-26

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
R561	5-241111-182	Resistor, 1.8 Kohms
R562	5-241111-123	Resistor, 12 Kohms
R563	5-241111-512	Resistor, 5.1 Kohms
R564	5-241111-272	Resistor, 2.7 Kohms
R565	5-241111-123	Resistor, 12 Kohms
R566	5-241111-152	Resistor, 1.5 Kohms
R567	5-241111-122	Resistor, 1.2 Kohms
R568	5-241111-123	Resistor, 12 Kohms
R569	5-241111-103	Resistor, 10 Kohms
R570	5-241111-512	Resistor, 5.1 Kohms
R571	5-115558-331	Resistor, 330 ohms, 1W, 5%
R572	5-241111-471	Resistor, 470 ohms
R573	5-115558-331	Resistor, 330 ohms, 1W, 5%
R574	5-241111-471	Resistor, 470 ohms
U501	287740	I.C., LM324
U502	286146	I.C., LM339
U503	293093	I.C., MPQ3904
U504	293094	I.C., MPQ3906
U505 thru U507	293093	I.C., MPQ3904
W1	267235	Jumper
	493618	Board, P.C.
	294058	Plate
	249438-9	Spacer
	294161	Insulator
	292900	Washer, Shoulder
	31-119918-4003	Screw, Pan Head



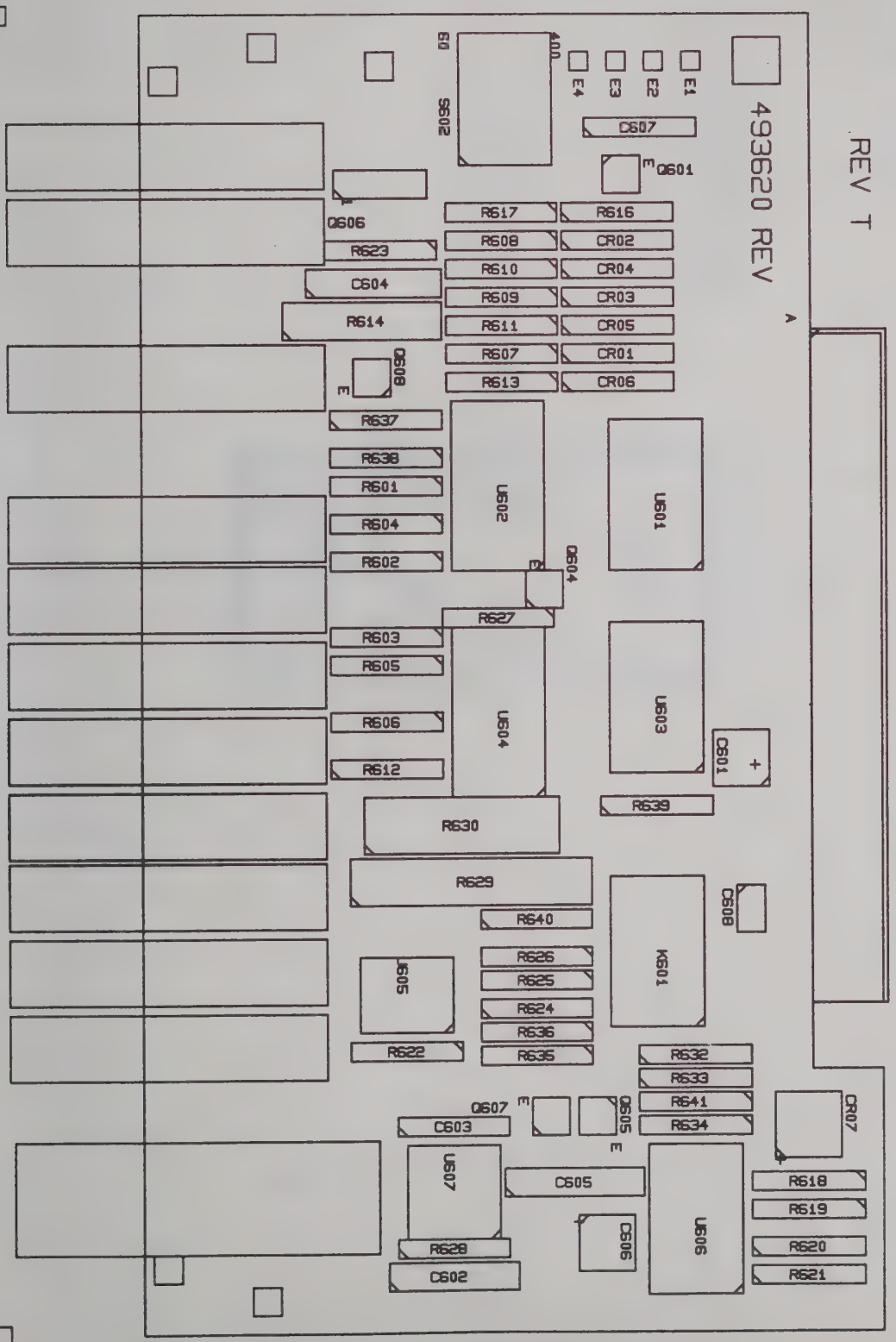
SWITCHING AMPLIFIER BOARD ASSEMBLY - 893618
FIGURE 6-26

2000S SERIES RECORDERS - INK WRITING MODELS
BOARD ASSY., SPEED SELECT 893620-1
FIGURE 6-27

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
C601	20-290244-107	Capacitor, 100 μfd, 10V
C602	10-125904-472	Capactior, .0047 μfd, 100V
C603	288755-104	Capacitor, .1 μfd, 50V
C607	288755-104	Capacitor, .1 μfd, 50V
C608	240352-101	Capacitor, 100 pfd, 1000V
CR601 thru CR606	280440	Diode, 1N4148
E1 thru E4	265763-3	Contact
K601	293735-3	Relay, Dry Reed
Q601	286141	Transistor, 2N3904
Q602	Not Used	
Q603	Not Used	
Q604	286141	Transistor, 2N3904
Q607, Q608	286141	Transistor, 2N3904
R601 thru R613	5-241111-102	Resistor, 1 Kohms
R615	Not Used	
R616	5-241111-273	Resistor, 27 Kohms
R617	5-241111-512	Resistor, 5.1 Kohms
R618	Not Used	
R625	Not Used	
R627	5-241111-511	Resistor, 510 ohms
R628	5-241111-622	Resistor, 6.2 Kohms
R631	Not Used	
R637	5-241111-272	Resistor, 2.7 Kohms
R638	5-241111-102	Resistor, 1 Kohms
R639	5-241111-271	Resistor, 270 ohms
R641	5-241111-102	Resistor, 1 Kohms
S601	292898	Switch, Pushbutton
U601	290169-10	I.C., 74LS10
U602	290169-157	I.C., 74LS157
U603	290169-04	I.C., 74LS04
U604	290169-157	I.C., 74LS157
U607	287613	I.C., NE555

2000S SERIES RECORDERS - INK WRITING MODELS
BOARD ASSY., SPEED SELECT 893620-1
FIGURE 6-27

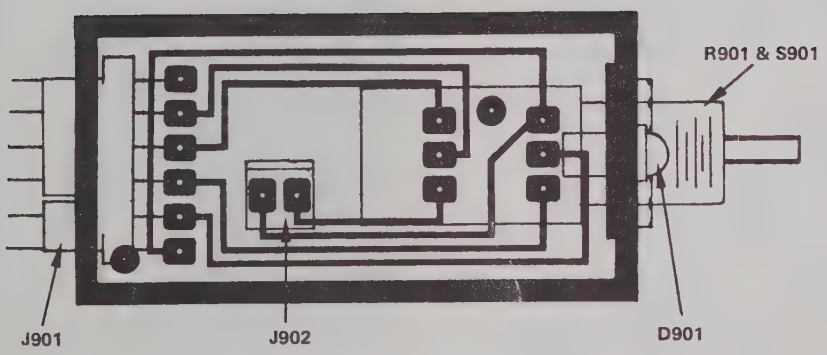
SYMBOL NUMBER	PART NUMBER	DESCRIPTION
	786080-1	Button, Engraved, "Power"
	786080-2	Button, Engraved, "STOP"
	786080-3	Button, Engraved, "5"
	786080-4	Button, Engraved, "10"
	786080-5	Button, Engraved, "25"
	786080-6	Button, Engraved, "50"
	786080-7	Button, Engraved, "100"
	786080-8	Button, Engraved, "200"
	786080-9	Button, Engraved, "÷ 100"
	786080-10	Button, Engraved, "LEFT"
	786080-11	Button, Engraved, "RIGHT"
	786080-41	Button, Engraved, "EXT"
	1-216741-402	Lockwasher, Spring
	31-119998-26	Nut
	31-119918-2604	Screw, Pan Head



SPEED SELECT BOARD ASSEMBLY - 893620-1
FIGURE 6-27

2000S SERIES RECORDERS - ALL MODELS
BOARD ASSY., VARIABLE SPEED 893621
FIGURE 6-28

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
D901	296672-1	Indicator, LED
J901	294310-6	Connector
J902	1-293983-2	Connector, Male
R901, S901	293271	Resistor, Variable - Switch
	696709	Bracket, LED Assembly (A-P)
	296707	Bracket
	293994-2	Connector
	-- -- -- -- -- * -- -- -- -- --	

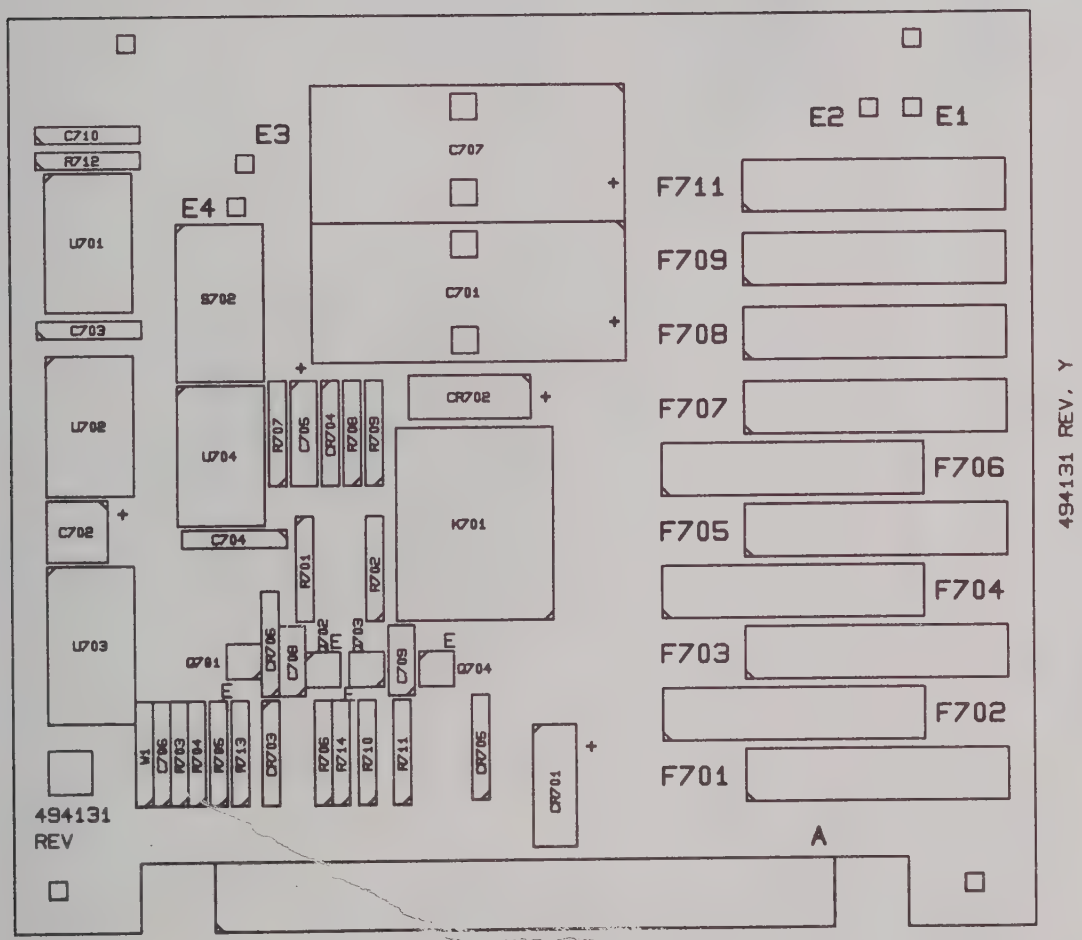


VARIABLE SPEED BOARD ASSEMBLY - 893621
FIGURE 6-28

2000S SERIES RECORDERS - INK WRITING MODELS
BOARD ASSY., CONTROL/TIMER 894131
FIGURE 6-29

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
C701	243037-257	Capacitor, 250 μfd, 50V
C702	20-290244-107	Capacitor, 100 μfd, 50V
C703, C704	288755-104	Capacitor, .1 μfd, 50V
C705	262585-475	Capacitor, 4.7 μfd, 20V
C706	288755-104	Capacitor, .1 μfd, 50V
C707	243037-257	Capacitor, 250 μfd, 50V
C708, C709	294069-104	Capacitor, .1 μfd, 10V
C710	287614-102	Capacitor, .001 μfd, 50V
CR701	286018-2	Diode, KBP04
CR702	286018-1	Diode, KBP02
CR703	269256-7	Diode, 1N4007
CR704	280440	Diode, 1N4148
CR705, CR706	269256-7	Diode, 1N4007
K701	291310-24	Relay
Q701	286143	Transistor, 2N3906
Q702	292538-2	Transistor, 2N6427
Q703	286143	Transistor, 2N3906
Q704	292538-2	Transistor, 2N6427
R701, R702	5-241111-332	Resistor, 3.3 Kohms
R703, R704	5-241111-472	Resistor, 4.7 Kohms
R705	5-241111-102	Resistor, 1 Kohms
R706	5-241111-472	Resistor, 4.7 Kohms
R707	5-241111-103	Resistor, 10 Kohms
R708, R709	5-241111-332	Resistor, 3.3 Kohms
R710	5-241111-472	Resistor, 4.7 Kohms
R711	5-241111-102	Resistor, 1 Kohms
R712	5-241111-472	Resistor, 4.7 Kohms
R713, R714	5-241111-332	Resistor, 3.3 Kohms
S701	268923	Switch (attaching parts included)
SP	285179	Switchplate
S702	286142-8	DIP Switch
U701	290169-92	I.C., 74LS92
U702	290169-90	I.C., 74LS90
U703	290169-390	I.C., 74LS390
U704	286016	I.C., 74121
HS	686397	Heatsink (A-P)
	31-119918-4004	Screw
	1-118195-304	Washer, Plain
	1-216741-411	Lockwasher
		-- -- -- -- -- * -- -- -- -- --
*FC	285577	Fuse Clip
Jumper	267235	Jumper Circuit
E1 thru E4	265763-3	Contact

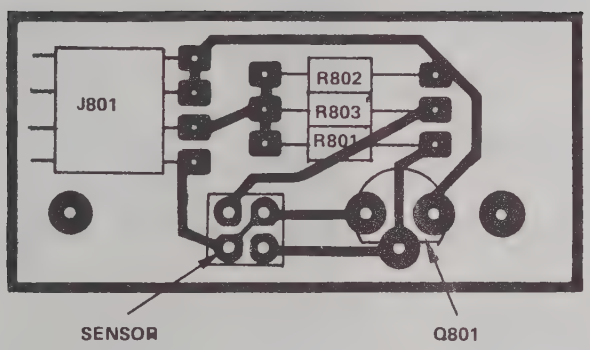
*NOTE: See Table 6-1, Fuse Table, for fuse ratings.



CONTROL/TIMER BOARD ASSEMBLY - 894131
FIGURE 6-29

2000S SERIES RECORDERS - ALL MODELS
BOARD ASSY., OPTICAL SENSOR 894133
FIGURE 6-30

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
J801	294310-4	Connector
Q801	286141	Transistor, 2N3904
R801	5-241111-243	Resistor, 24 Kohms
R802	5-241111-512	Resistor, 5.1 Kohms
R803	5-241111-910	Resistor, 91 ohms
	285470	Sensor



OPTICAL SENSOR BOARD ASSEMBLY - 894133
FIGURE 6-30

2000S SERIES RECORDERS - ALL MODELS
BOARD ASSY., PROCESSOR/MICROCOMPUTER 896073
FIGURE 6-31

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
C1, C2	288755-104	Capacitor, .1 μfd
C3, C4	20-290244-107	Capacitor, 100 μfd
C5	280865-156	Capacitor, 15 μfd
C6, C7	288755-104	Capacitor, .1 μfd
C8, C9	280865-156	Capacitor, 15 μfd
C10	288755-104	Capacitor, .1 μfd
C11	280865-156	Capacitor, 15 μfd
C12	240352-5R0	Capacitor, 5 pfd
C13	288755-104	Capacitor, .1 μfd
C14	280865-156	Capacitor, 15 μfd
C15	282927-502	Capacitor, .005 μfd
C16	283943-476	Capacitor, 47 μfd
C17	288755-104	Capacitor, .1 μfd
C18	20-285066-1	Capacitor, 1 μfd
C19 thru C31	288755-104	Capacitor, .1 μfd
C32 thru C35	240352-220	Capacitor, 22 pfd
C36	232920-336	Capacitor, 33 μfd
C37	287614-224	Capacitor, .22 μfd
C38	240352-331	Capacitor, 330 pfd
C39	280865-156	Capacitor, 15 μfd
C40 thru C44	288755-104	Capacitor, .1 μfd
C45	10-290081-335	Capacitor, 3.3 μfd
CR1 thru CR8	280440	Diode, 1N4148
J1	294310-4	Connector
J2	294310-6	Connector
J3	294310-9	Connector
J4	294310-6	Connector
J5	294310-9	Connector
J6	294063-9	Connector
J7	294310-9	Connector
J8	294310-4	Connector
J9	2-286008-10	Connector
Q1	286143	Transistor, 2N3906

2000S SERIES RECORDERS - ALL MODELS
BOARD ASSY., PROCESSOR/MICROCOMPUTER 896073
FIGURE 6-31

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
R1	1-281851-10001	Resistor, 10 Kohms
R2	1-281851-40000	Resistor, 4 Kohms
R3	1-281851-10000	Resistor, 1 Kohms
R4	5-241111-202	Resistor, 2 Kohms
R5	5-241111-103	Resistor, 10 Kohms
R6	5-241111-332	Resistor, 3.3 Kohms
R7	5-241111-472	Resistor, 4.7 Kohms
R8	1-281851-20001	Resistor, 20 Kohms
R9 thru R11	5-241111-512	Resistor, 5.1 Kohms
R12	5-241111-912	Resistor, 9.1 Kohms
R13	5-241111-274	Resistor, 270 Kohms
R14	5-241111-102	Resistor, 1 Kohms
R15	1-281851-80001	Resistor, 80 Kohms
R16	5-241111-433	Resistor, 43 Kohms
R17	1-281851-10002	Resistor, 100 Kohms
R18	1-281851-10001	Resistor, 10 Kohms
R19	5-241111-472	Resistor, 4.7 Kohms
R20	1-281851-10001	Resistor, 10 Kohms
R21	5-241111-472	Resistor, 4.7 Kohms
R22	5-241111-104	Resistor, 100 Kohms
R23	269085-502	Resistor, 5 Kohms
R24	1-281851-12101	Resistor, 12.1 Kohms
R25	1-281851-10002	Resistor, 100 Kohms
R26	5-241111-470	Resistor, 47 Kohms
R27	1-281851-43200	Resistor, 4.32 Kohms
R28	5-241111-101	Resistor, 100 ohms
R29	5-241111-202	Resistor, 2 Kohms
R30 thru R32	5-241111-102	Resistor, 1 Kohms
R33	5-241111-362	Resistor, 3.6 Kohms
R34	5-241111-102	Resistor, 1 Kohms
R35	5-241111-202	Resistor, 2 Kohms
R36	5-241111-332	Resistor, 3.3 Kohms
R37	5-241111-102	Resistor, 1 Kohms
R38	5-241111-202	Resistor, 2 Kohms
R39	5-241111-102	Resistor, 1 Kohms
R40	5-241111-106	Resistor, 10 Megohms
R41	5-241111-103	Resistor, 10 Kohms
R42	5-241111-103	Resistor, 10 Kohms

2000S SERIES RECORDERS - ALL MODELS
BOARD ASSY., PROCESSOR/MICROCOMPUTER 896073
FIGURE 6-31

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
R43	5-241111-203	Resistor, 20 Kohms
R44	5-241111-332	Resistor, 3.3 Kohms
RN1, RN2	1-283274-102	Resistor, 1 Kohms
RN3	3-283274-271	Resistor, 270 ohms
SK1	292709-16	Socket, 16 pin
SK2 thru SK5	288487-40	Socket, 40 pin
SK6, SK7	288487-24	Socket, 24 pin
SK8	288487-28	Socket, 28 pin
SW1	286142-8	Switch, DIP
SW2	286142-6	Switch, DIP
TP1 thru TP3	265763-3	Contact
TS1	293435-5	Jumper
U1	290305-071	I.C., 14071 CMOS
U2	286158-1	I.C., 14520 CMOS
U3	284681	I.C., 14013 CMOS
U4	290169-125	I.C., 74LS125
U5	296273	I.C., Custom Gate Array
U6	293090	I.C., 6502 MOS
U7	290305-001	I.C., 14001 CMOS
U8, U9	284681	I.C., 14013 CMOS
U10	294199	I.C., 8126 CMOS
U11	284681	I.C., 14013 CMOS
U12	290305-538	I.C., 14538 CMOS
U13	291587	I.C., 6810 MOS
U14	696577-03	* I.C., 2716 MOS Pre-Programmed
U15	295654	I.C., 1488
U16	290169-14	I.C., 74LS14
U17	290169-125	I.C., 74LS125
U18	290305-081	I.C., 14081 CMOS
U19	290169-155	I.C., 74LS155
U20	290169-244	I.C., 74LS244
U21	290169-125	I.C., 74LS125
U22	290169-624	I.C., 74LS624
U23	295653	I.C., 1489
U24	293086	I.C., LM331 Linear
U25	293085	I.C., AD7524 CMOS

*NOTE: U14 must be at least Rev. C if unit is equipped with Single Piece Motor Mount 696692.

2000S SERIES RECORDERS - ALL MODELS
BOARD ASSY., PROCESSOR/MICROCOMPUTER 896073
FIGURE 6-31

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
U26	290169-125	I.C., 74LS125
U27	287740	I.C., LM324 Linear
U28	293085	I.C., AD7524 CMOS
U29	291588	I.C., 6821 MOS
U30	696821-01*	I.C., 2764 MOS Pre-Programmed
U31	296540	I.C., 6803 MOS
U32	283948	I.C., LM1458 Linear
U33	293085	I.C., AD7524 CMOS
U34	290169-74	I.C., 74LS74
U35, U36	296613	I.C., MPQ3725A
U37	296537	I.C., 74SC374 CMOS
U38	296536	I.C., 146818 CMOS
U39	290169-373	I.C., 74LS373
U40	296674-138	I.C., 74HC138 CMOS
U41	296603	I.C., TND908
Y1	289053-4	Crystal 4.0 MHz
Y2	289053-8	Crystal 5.068 MHz
Y3	289053-12*	Crystal 1.048576
W1	267235	Jumper
	230820-1	Foam, Adhesive Backed
	249438-9	Spacer
	232997-23	Retaining Strap

*NOTE: Prior to Revision L, these part numbers were used. After Revision L they were changed to 696821-02 for U30, and 289053-13 for Y3. (4.194304 MHz)

Check the Revision level of board in selecting the correct part number.

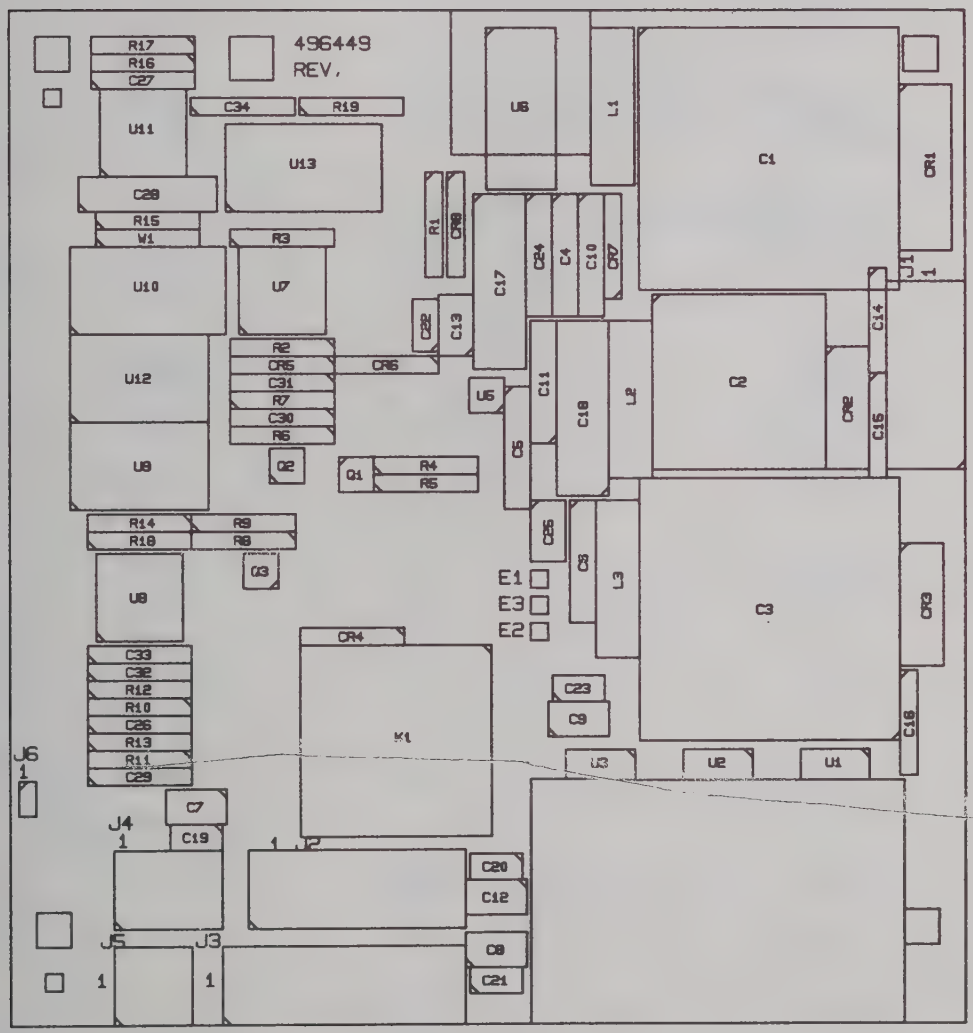
PROCESSOR/MICROCOMPUTER BOARD ASSEMBLY - 896073
FIGURE 6-31

2000S SERIES RECORDERS - ALL MODELS
BOARD ASSY., POWER SUPPLY 896449
FIGURE 6-32

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
C1	288755-103	Capacitor, .01 μfd, 50V
C2	286010-108	Capacitor, 1000 μfd, 50V
C3	294301-908	Capacitor, 9000 μfd, 25V
C4 thru C6	288755-474	Capacitor, .47 μfd, 50V
C7 thru C9	283943-156	Capacitor, 15 μfd, 20V
C10, C11	288755-474	Capacitor, .47 μfd, 50V
C12, C13	283943-156	Capacitor, 15 μfd, 20V
C14 thru C16	288755-104	Capacitor, .1 μfd, 50V
C17, C18	287618-156	Capacitor, 15 μfd, 35V
C19 thru C21	281344-103	Capacitor, .01 μfd, 100V
C22, C23	294069-104	Capacitor, .1 μfd, 10V
C24	288755-474	Capacitor, .47 μfd, 50V
C25	283943-107	Capacitor, 100 μfd, 20V
C26, C27	288755-103	Capacitor, .01 μfd, 50V
C28	10-125904-682	Capacitor, .0068 μfd, 100V
C29 thru C32	288755-103	Capacitor, .01 μfd, 50V
C33	288755-104	Capacitor, .1 μfd, 50V
CR1	283651-2	Diode Assembly
CR2, CR3	286018-2	Diode Assembly
CR4	269256-7	Diode, 1N4007
CR5, CR6	289662	Diode, 1N914
CR7	269256-7	Diode, 1N4007
CR8	230061-10	Diode, Zener 1N4735A
E1 thru E3	265763-3	Contact, Electrical
H1	694057	Heat Sink, Modified
H2	293324-1	Heat Sink
J1	281711-6	Connector, Male
J2	281711-8	Connector, Male
J3	281711-9	Connector, Male

2000S SERIES RECORDERS - ALL MODELS
BOARD ASSY., POWER SUPPLY 896449
FIGURE 6-32

SYMBOL NUMBER	PART NUMBER	DESCRIPTION
J4	281711-4	Connector, Male
J5	281711-3	Connector, Male
J6	281711-2	Connector, Male
K1	285771-24	Relay
L1	291224-1	Inductor, 8.2 μH
L2, L3	291224-1	Inductor, 8.2 μH
Q1	281848-1	Transistor, MPS A14
Q2	286143	Transistor, 2N3906
Q3	286141	Transistor, 2N3904
R1	5-241111-220	Resistor, 22 ohms
R2	1-281851-33003	Resistor, 3.3 Megohms
R3	1-281851-20003	Resistor, 2 Megohms
R4	5-241111-912	Resistor, 9.1 Kohms
R5	5-241111-822	Resistor, 8.2 Kohms
R6	1-281851-47003	Resistor, 4.7 Megohms
R7	1-281851-82502	Resistor, 825 Kohms
R8.	25-281851-536R0	Resistor, 536 ohms
R9	25-281851-40200	Resistor, 4.02 Kohms
R10	1-281851-20000	Resistor, 2 Kohms
R11 thru R13	1-281851-30000	Resistor, 3 Kohms
R14	5-241111-202	Resistor, 2 Kohms
R15	5-241111-102	Resistor, 1 Kohm
R16	1-281851-70000	Resistor, 7 Kohms
R17	1-281851-30000	Resistor, 3 Kohms
R18	5-241111-752	Resistor, 7.5 Kohms
R19	5-241111-684	Resistor, 680 Kohms
U1	285461	I.C., 7815
U2	285778	I.C., 7915
U3	285317	I.C., 7805
U4	Not Used	
U5	289897	I.C., 79L05
U6	295796	I.C., LM317
U7	296604	I.C., LM4250C
U8	291305	I.C., LM311
U9	290305-001	I.C., 14001, CMOS
U10	286158-1	I.C., 14520, CMOS
U11	287613	I.C., LM555
U12	290305-071	I.C., 14071, CMOS
U13	290305-538	I.C., 14538, CMOS
W1	267235	Jumper
	293848-3	Insulator, Heat Sink
	292900	Washer, Shoulder
	796716	Heat Sink Assembly
	123253-201	Spacer, Threaded
	296105	I.C., LM338
	265311	Kit, Transistor Mounting
	293848-1	Insulator, Silpad



496449 REV. A

POWER SUPPLY BOARD ASSEMBLY - 896449
FIGURE 6-32

2800S RECORDER – RACK MOUNT MODELS (As Specified)
750 WATT POWER KITS - ISOLATED (884206-5 & -6; Wiring Diagram 384961)
750 WATT POWER KITS (884208-5 & -6; Wiring Diagrams 384919 & 393042)
FIGURE 6-33

ITEM NUMBER	PART NUMBER	DESCRIPTION	SYMBOL NUMBER	*USED ON
1	284797	Cable		A, B
1	744079	Cable Assy		C, D
2	265840-2	Terminal, Lug		
3	667067	Cover Assy, Terminal Board (A-P)		
	31-119918-6218	Screw, Machine		
	1-118195-305	Washer		
		-----*-----		
4	267050-10	Terminal Board	TB-11	
5	267069	Plate, Mounting		
6	124803-3	Clamp, (A-P)		
	31-119918-6206	Screw, Machine		
	1-118195-305	Washer		
	1-216741-420	Lockwasher		
		-----*-----		
7	249698	Spacer, Strip		
8	886935	Panel Assy		
9	1-284874-1	Switch, Pushbutton	S-1	A, C
9	1-284874-3	Switch, Pushbutton	S-1	B, D
10	241026-14	Terminal, Lug		
11	485910	Connector Panel		
12	286457	Panel Cover (A-P)		
	31-119918-4005	Screw, Machine		
	1-216741-410	Lockwasher		
	31-119998-40	Nut, Hex		
		-----*-----		
13	285241	Cover Plate (A-P)		
	31-119918-4005	Screw, Machine		
	1-216741-410	Lockwasher		
	31-119998-40	Nut, Hex		
		-----*-----		
14	884914	Plate Assy, Identification		A, C
14	885391	Plate Assy, Identification (A-P)		B, D
	31-119918-2603	Screw, Machine		
		-----*-----		
15	245279	Plate, Identification (230 Vac) (A-P)		B, D
	13-262716-2604	Screw, Self Tapping		B, D

* USED ON code differs from standard on this parts list as follows:

884206-5 = A, (115V) 884206-6 = B, (230V)
884208-5 = C, (115V) 884208-6 = D, (230V)

If USED ON column is blank, item is common to A, B, C & D.

2800S RECORDER -- RACK MOUNT MODELS (As Specified)
750 WATT POWER KITS - ISOLATED (884206-5 & -6; Wiring Diagram 384961)
750 WATT POWER KITS (884208-5 & -6; Wiring Diagrams 384919 & 393042)
FIGURE 6-33

ITEM NUMBER	PART NUMBER	DESCRIPTION	SYMBOL NUMBER	*USED ON
16	382959-4	Transformer, Isolation	T-1	A
16	382959-5	Transformer, Isolation	T-1	B
		(A-P)		
	31-119914-4507	Screw, Machine		A, B
	1-216741-440	Lockwasher		A, B
	31-119998-45	Nut, Hex		A, B
		------*------		
17	385915	Bracket, Mtg (Shipping Frame Only)		A, B
18	684376	Cover Assy, Terminal Board		A, B
19	265814-4	Terminal Board	TB-102	A, B
		(A-P)		
	31-119918-6216	Screw, Machine (Used for items 18 & 19)		A, B
	1-216741-420	Lockwasher (Used for item 18 & 19)		A, B
		------*------		
20	384367	Bracket, Term Bd. (Mount with transformer screws.)		A, B
21	285489	Bracket, Chain (Lctd. underside of Cab.)		A, B
		(A-P)		
	31-119924-4508	Screw, Machine		A, B
	243898-44	Nut Assy		A, B
		------*------		
22	285491	Chain, Static		A, B
		(A-P)		
	31-119918-8206	Screw, Machine		A, B
	1-216741-425	Lockwasher		A, B
		------*------		
23	684964	Cable Assy, Power (115V)		A
23	684965	Cable Assy, Power (230V)		B
24	684982	Cable Assy, Power (115V)		C
24	685675	Cable Assy, Power (230V)		D
25	113182-10	Fuse, 10 Amp (115V)	F-1	A, C
25	113182-5	Fuse, 5 Amp (230V)	F-1	B, D
26	129758	Fuseholder		
27	284866	Connector (115V)	J-1	A, C
27	284868	Connector (230V)	J-1	B. D
		(A-P)		
	31-119918-6206	Screw, Machine		
	1-216741-420	Lockwasher		
	31-119998-62	Nut, Hex		
		------*------		
28	767077	Bracket Assy		
		(A-P)		
	31-119918-6204	Screw, Machine		
		------*------		
29	265814-10	Terminal Board		
30	667067	Cover Assy, Terminal Board		
		(A-P)		
	31-119918-6218	Screw, Machine		
	1-118195-305	Washer		
		------*------		
31	270160-1	Terminal, Quick Disconnect		

* USED ON code explanation. See previous page.

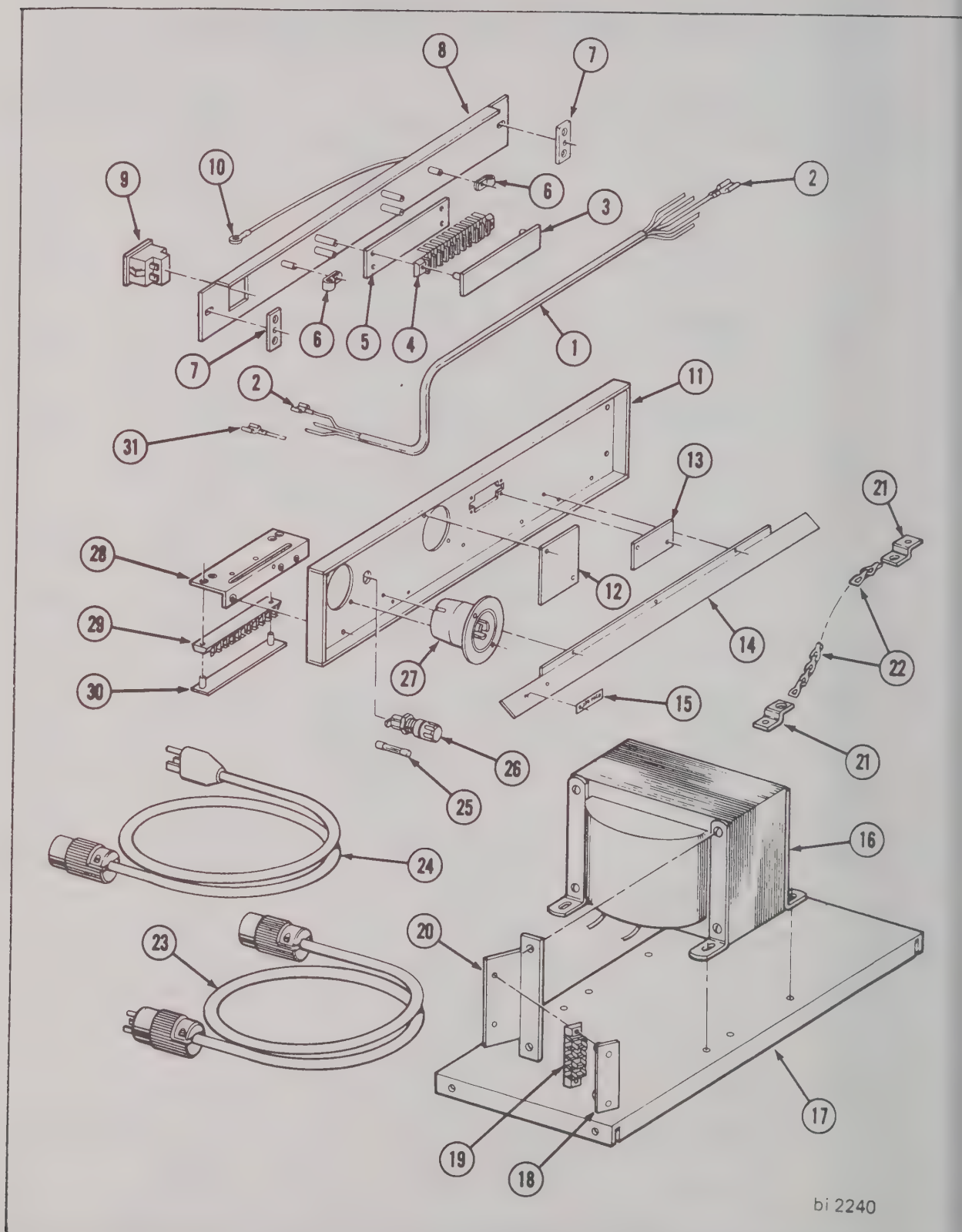


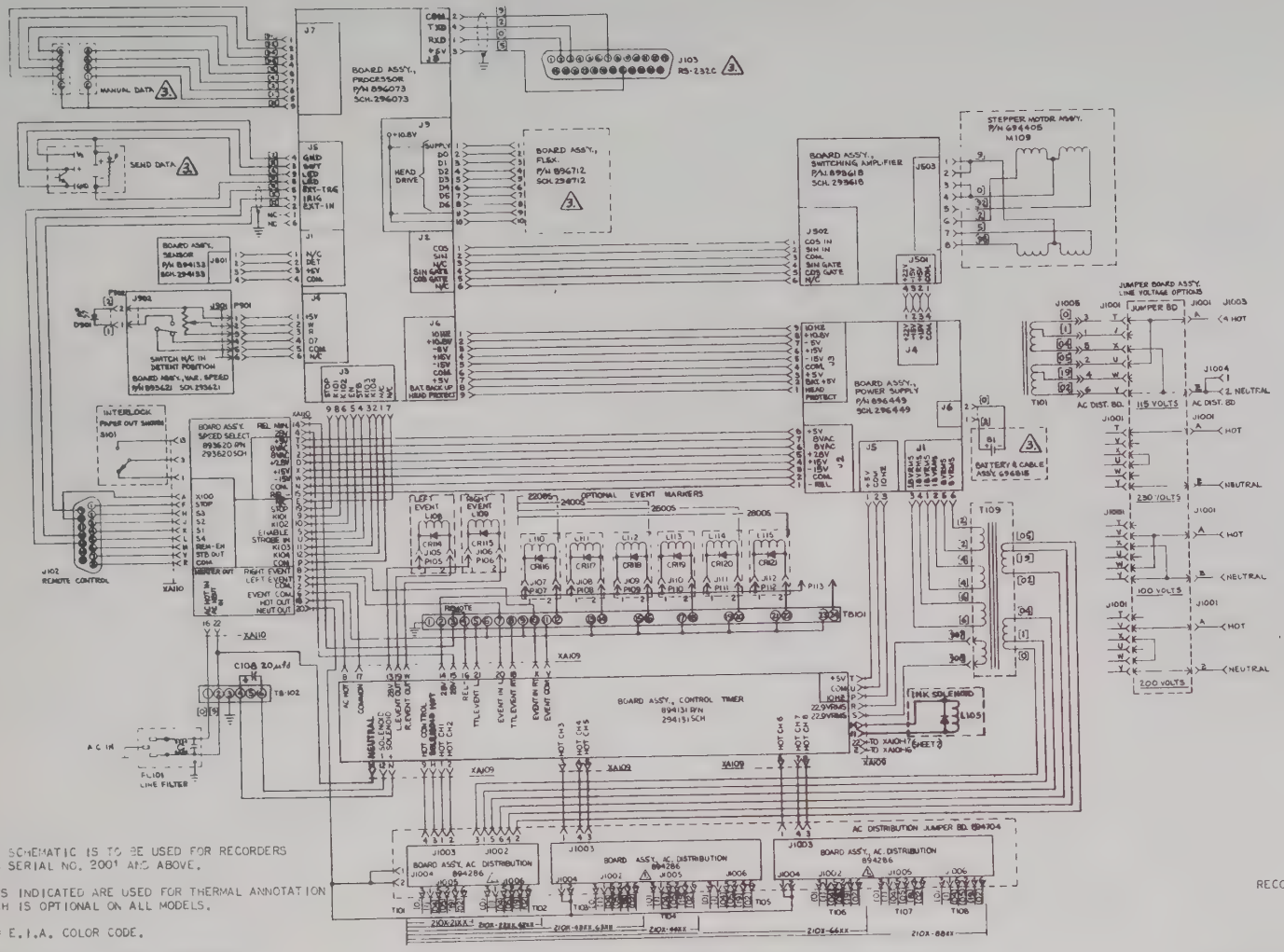
FIGURE 6-33 750-WATT POWER KIT & ISOLATED POWER KIT

APPENDIX
SCHEMATIC DIAGRAMS

Below is the list of schematic diagrams which apply to this recorder. The schematics follow this page in the order they are listed and include the assembly name and number which they apply to.

SCHEMATIC DIAGRAMS

SCHEMATIC NUMBER	REV LEVEL	ASSEMBLY NAME	ASSEMBLY NUMBER
296837		Recorder Assembly	2107-88XX-XX
292273	D	Drive Amp Board	886220
293618	P	Switching Amp Board	893618
293620	T	Speed Select Board	893620
293621	G	Variable Speed Board	893621
294131	Y	Control Timer Board	894131
294133	H	Sensor Board	894133
296073	M	Processor/Microcomputer Board	896073
296449	L	Power Supply/Head Protect	896449
384919	F	Power Kit	884208-1,-3,-5
384920	E	Power Kit	884208-2,-4
384961	H	Power Kit	884206
393042	B	Power Kit	884208-6
393130	E	Power Kit	893136
294704	B	A.C. Dist. Jumper Board	494704
294286	J	A.C. Dist. Board Assy.	894286
296820	A	Annotation Kit Assy.	11-2123-51



4. THIS SCHEMATIC IS TO BE USED FOR RECORDERS WITH SERIAL NO. 2001 AND ABOVE.

3. ITEMS INDICATED ARE USED FOR THERMAL ANNOTATION WHICH IS OPTIONAL ON ALL MODELS.

2. [ ] = E.I.A. COLOR CODE.

1. FIGURE 1. TYPICAL WIRING FOR PRIMARIES OF T101 THRU T109.

NOTES:

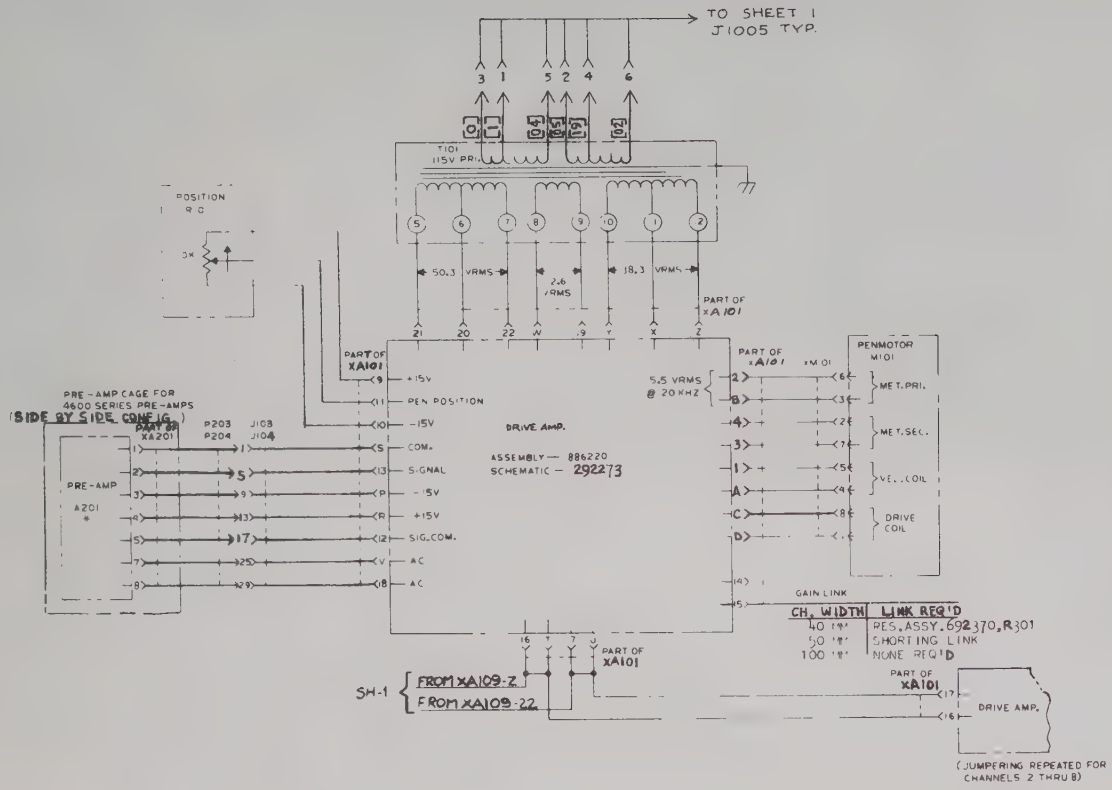
RECORDER ASSY. 2107-8890-XX
2107-6690-XX
2107-4490-XX
2107-2290-XX

BY	DATE	NAME	SCHEMATIC
SWARTZ	10-83		10006 INK
		CODE IDENT	96795
		ISSUE CODE	G

Gould Inc. Instruments Division Cleveland, Ohio 44114 U.S.A.
DWG NO. 296837
PG. 1 OF 2

296837

REVISIONS		
SYM	DESCRIPTION	DATE

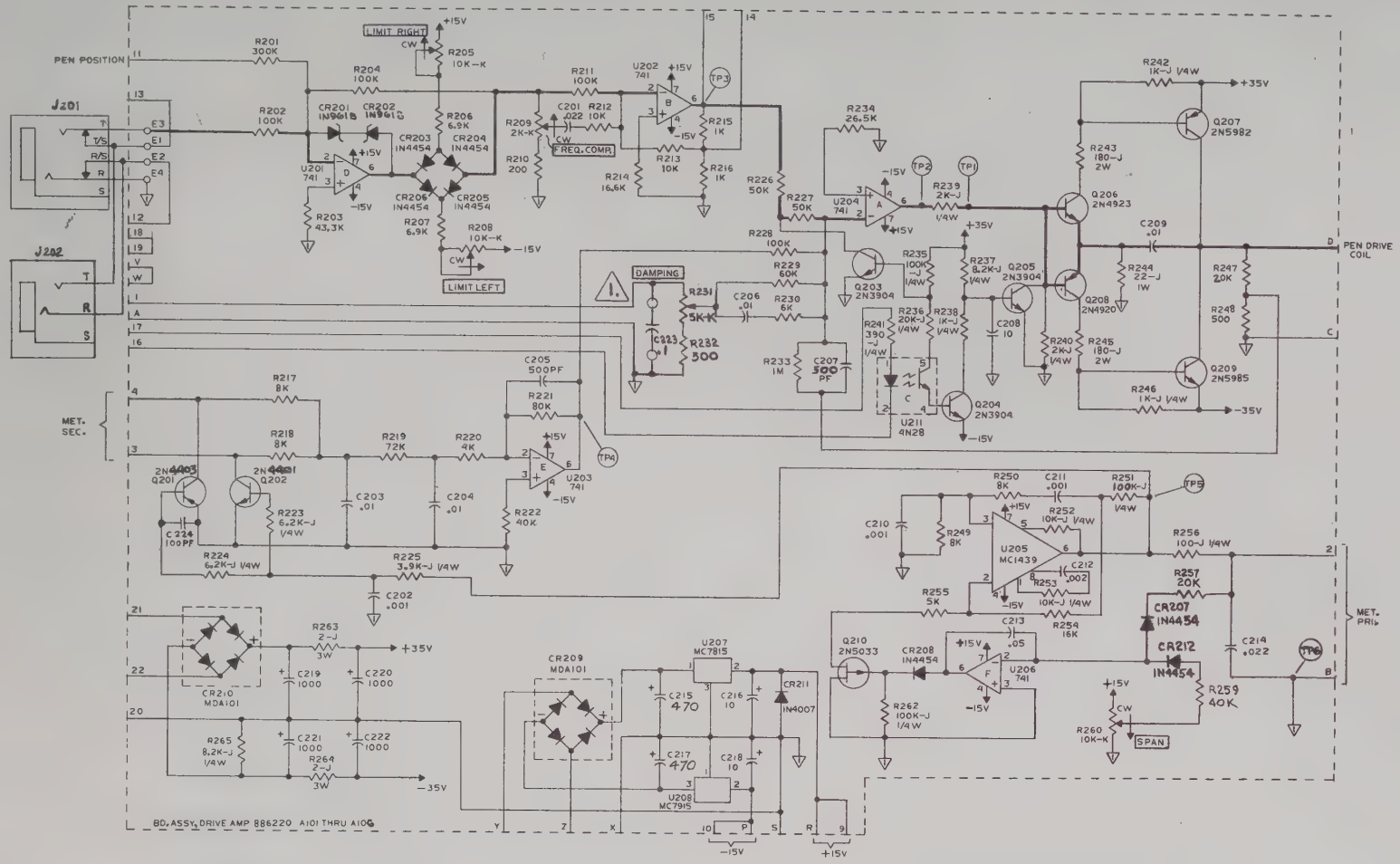


CH. 1 THRU 8 CONNECTION TABLE FOR 2400S, 2600S, 2800S RECORDERS							
CH.	P203/J103 TERM USED						
1	1	5	9	13	17	25	29
2	2	6	10	14	18	26	30
3	3	7	11	15	19	27	31
4	4	8	12	16	20	28	32
	P204/J104 TERM USED						
5	1	5	9	13	17	25	29
6	2	6	10	14	18	26	30
7	3	7	11	15	19	27	31
8	4	8	12	16	20	28	32
FOR 2200S RECORDERS							
CH.	P203/J103 TERM USED						
1	1	4	7	10	13	11	14
2	3	6	9	12	15	2	5

DR SWARTZ 10-83	NAME SCALE AS NOTED	Gould Inc Instruments Division Cleveland, Ohio 44114 U.S.A.	
	CODE IDENT 06795	DWG NO 296837	

296837

REV. D-1



1 C223 USED ONLY IN 80 MM APPLICATIONS.

NOTES:

BY	DATE	NAME	SCHEMATIC AMPLIFIER ASSY. DRIVE 886220	Gould Inc. Instruments Division Cleveland, Ohio 44114 U.S.A.
DR R. CLARK	2/8/77			
CH				
APP	2/11	CODE IDENT 96795	ISSUE CODE G	DWG 292273

292273

82
21

ON	DATE
ED PER RE- CN 27943 HAMILTON	5-21- 81
D PER DCN ONES	8-12-81

SYM	DESCRIPTION	DATE
E-1	NOT AFFECTED PER DCN 27555/C. WILLS	1-30-81
F-1	NOT AFFECTED PER DCN 27943 /S. JONES	4-6-81
G-1	NOT AFFECTED PER DCN 28084 C. WILLS	4-6-81

SYM	DESCRIPTION	DATE
C-4	NOT AFFECTED PER DCN 26921 S. HAMMOND	9-4-80
D-1	REVISED PER DCN 27366 J. DAVIS	12-4-80

REVISIONS

SYM	DESCRIPTION	DATE
A-1	NOT AFFECTED PER DCN 26306/C. WILLS	-1-80
B-1	CR501 THRU CR511 WERE D501 THRU D511 // PER DCN 26498/M. LOMBARDO	5-9-
C-1	REVERSED PIN DESIGNATIONS	
C-2	PER DCN 26920 S. HAMMOND	9-4-
C-3	C503 WAS .01u	
	CR505,07,09,11 WERE UTR40	

Q-1	NOT AFFECTED PER DCN 29978 S. JONES	9-28-82

POWER SECTION

J502-4 J502-5 J502-6

J503-8 J503-2 J503-7 J503-1 J503-6 J503-4 J503-5 J503-3

MTR

BD. ASS'Y., SWITCHING 893618

BY	DATE	NAME SCHEMATIC	Gould Inc. Instruments Division Cleveland, Ohio 44114
DR WILLS	10/79		
CH	3/80		
APP	3/80		
		CODE IDENT. 96795 / ISSUE CODE G	DWG NO 293618

SYM	DESCRIPTION	DATE	APPROVED
M-1	NOT AFFECTED PER DCN 29485 / S. JONES	4-29-82	
N-1	REVISED PER DCN 29710 SOTERO	6-8-82	
P-1	NOT AFFECTED PER DCN 29711/A. SOTEROS	6-8-82	
K-1	NOT AFFECTED PER DCN 28779/ S. JONES	11-6-81	
L-1	REV'D NOTE 2 PER DCN 28873 / S. JONES	11-6-81	
H-1	NOT AFFE... ISSUE OF K		
J-1	NOT AFFEC... 28405 / S		

CONTINUED RIGHT MOST EDGE THIS DRAWING

W1

+15 R501 5.1K R502 10K

U501 LM324 Q509 2N3906 R503 2.7K C503 .006u Q510 2N3904

U502 LM339 R504 10K R505 1K R508 1K CR01 IN914 R506 18K R507 270K Q511 2N3904

SAWTOOTH GENERATOR

U502 LM339 R509 12K CR02 IN914 R510 5.1K

PULSE WIDTH MODULATOR

U502 LM339 R515 5.1K CR03 IN914

ERROR AMPLIFIER

R511 2.2M C505 100 Pf

R512 9.1K R513 9.1K R514 2K R520 12K

U501 LM324

J502-2 SIN IN

J502-3 COM

R518 C504 2.2M 100Pf R516 9.1K R517 9.1K R519 2K

J502-1 COS IN

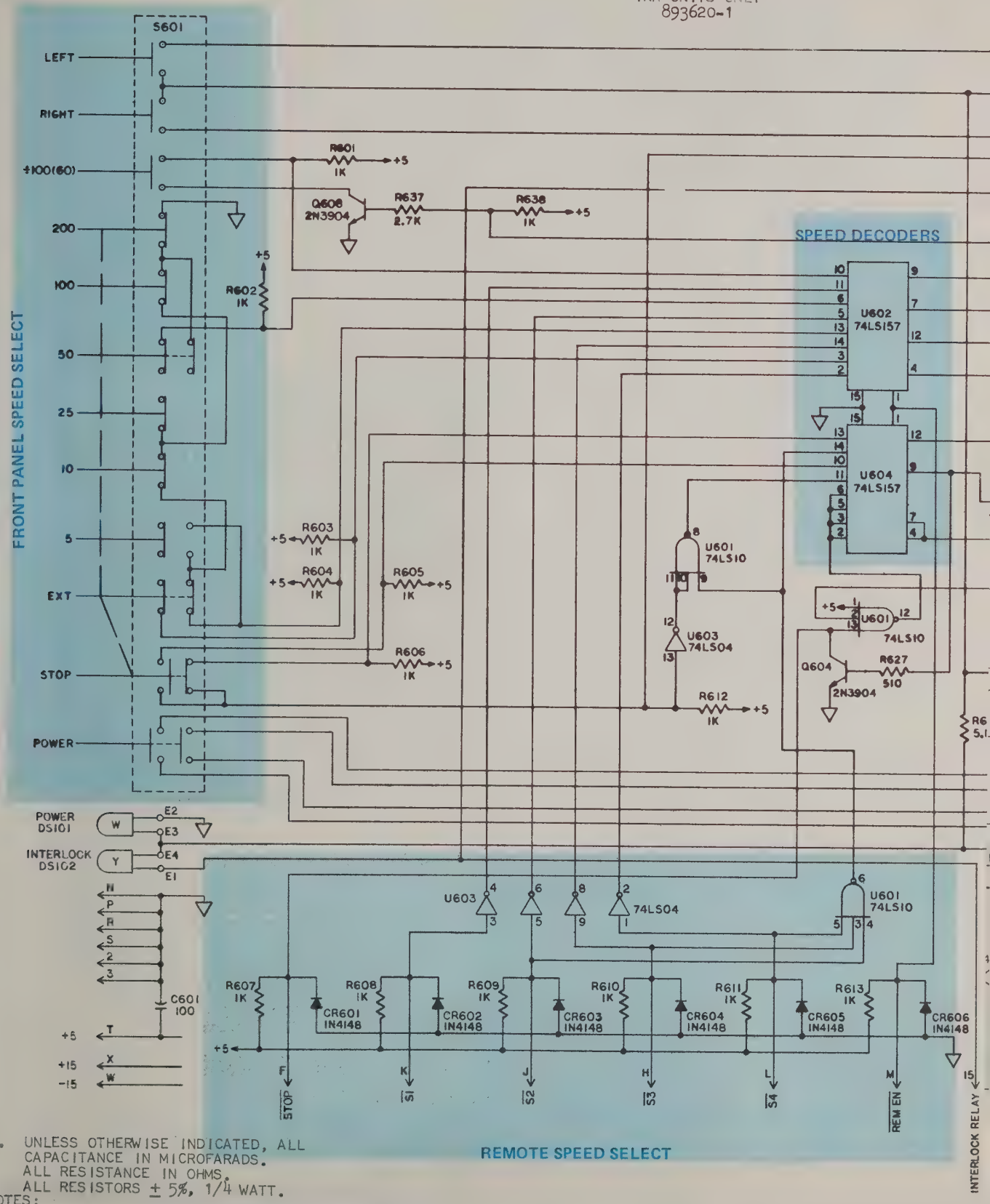
J501-2 J501-1 J501-3 J501-4 C501 20μ C502 20μ +15 COM -15 +22

2. TRANS. Q501 THRU 508 (2N6107) ARE HEATSINKED TO CHASSIS

1. ALL RESISTORS ARE 1/4W 5%.

NOTES: UNLESS OTHERWISE SPECIFIED

INK UNITS ONLY
893620-1



NOTES:
1. UNLESS OTHERWISE INDICATED, ALL CAPACITANCE IN MICROFARADS. ALL RESISTANCE IN OHMS. ALL RESISTORS ± 5%, 1/4 WATT.

REVISIONS		
SYM.	DESCRIPTION	DATE
T-1	REVISED AND REDRAWN DCN 31057/A. SOTEROS	11-28-83M

7 → LEFT EVENT

6 → EVENT COM

8 → RIGHT EVENT

13 NO
3
1 NL
2
INTERLOCK PAPER OUT SHOWN

A → INK

THIS SIDE OF DOTTED LINE IS FOR THERMAL UNITS ONLY 893620-2.

9 → K101

10 → K102

11 → K103

12 → K104

R639 270 — 19 → STOP — C608 100pf

U603 74LS04

+5 — K601 — 14 → RELAY COMMON

5 → ENABLE

R616 27K — Q601 2N3904 — C607 .1

17 K

HEAT PEN TRANSFORMER DRIVE

R622 470 — R629 5.1K 5W — B → HEATOUT

U605 MOC3009

Q606 2N6155

C604 .01pf

R623 100K — R630 1K 1W — R614 220

1 2 3
FRONT VIEW (TYP.)

SAWTOOTH GENERATOR

+15 — R620 15K — R619 10K — R621 110 — R618 1K

U606 LM339

R625 5.1K — R624 3.3K — Q605 2N3906

C605 .1

CR607 VE18X

TRIAC "ON" TIME CONTROLLER

+15 — R635 20K

R632 820K — R633 82K

U606 LM339

R636 10K — Q607 2N3904

-15

STROBE PULSE STRETCHER

+5 — R628 6.2K — C602 .0047 — U607 NE555 — R641 1K — C603 .1

R626 9.1K — R640 43K — S602

S602
60-400HZ SWITCH
(SHOWN IN 60HZ POSITION)

60/400 HZ SWITCH

R634 10K

C606 4.7

D 4 16 22 20 21 18 17 U — +24 — AC HOT IN — AC NEUT IN — AC NEUT OUT — AC HOT OUT — AC HEAT IN — STROBE IN

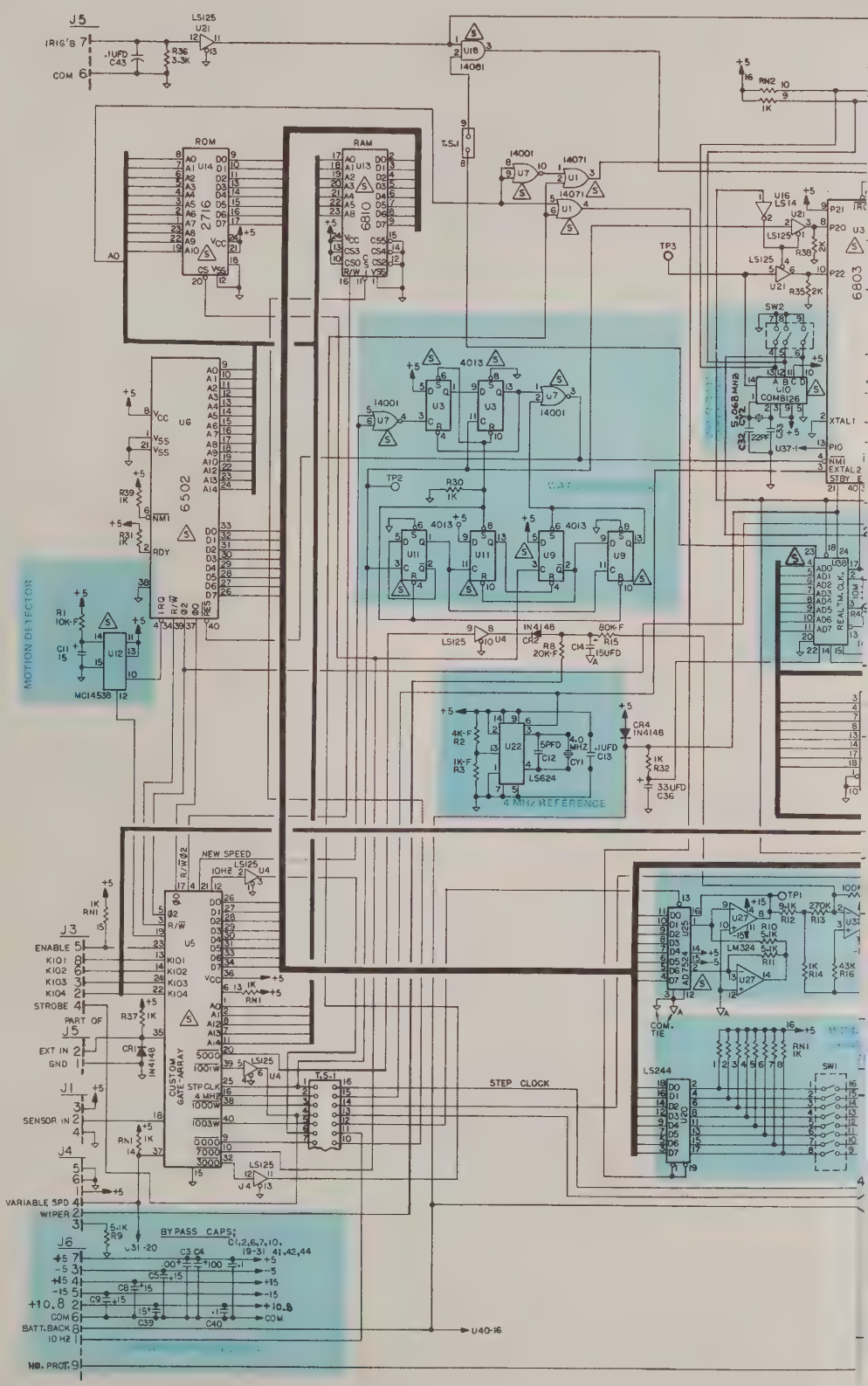
V — STROBE OUT

Z — AC REF

Y — AC REF

BOARD ASS'Y., SPEED SELECT 893620-1 & -2

BY	DATE	NAME	Gould Inc. Instruments Division Cleveland, Ohio 44114 U.S.A.
DR WILLS	3/80	SCHEMATIC	
CH LENARCIC	4/80		
APP DANIEL	4-1-80	CODE IDENT. 96795	ISSUE CODE G
			DWG. NO. 293620

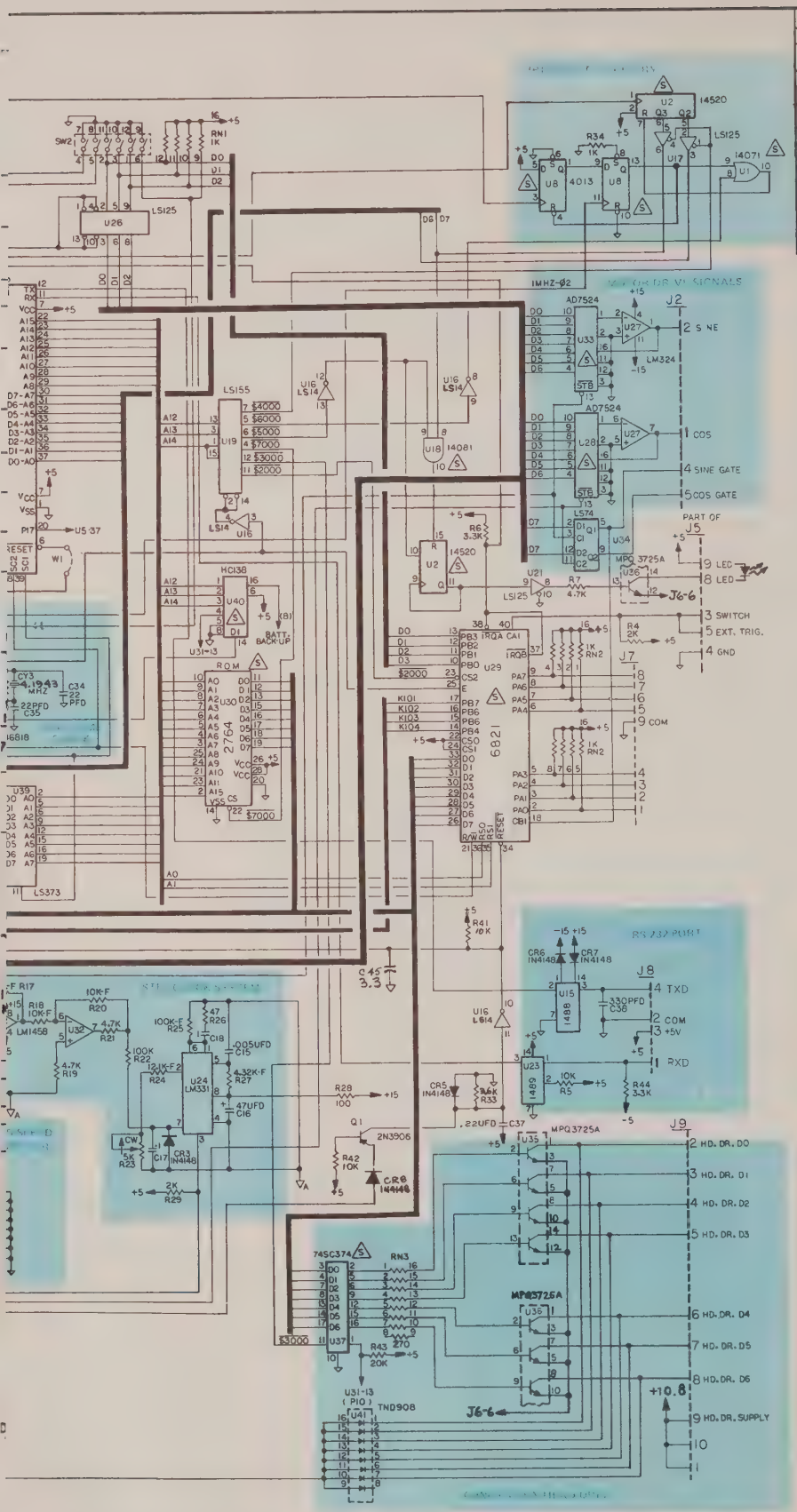


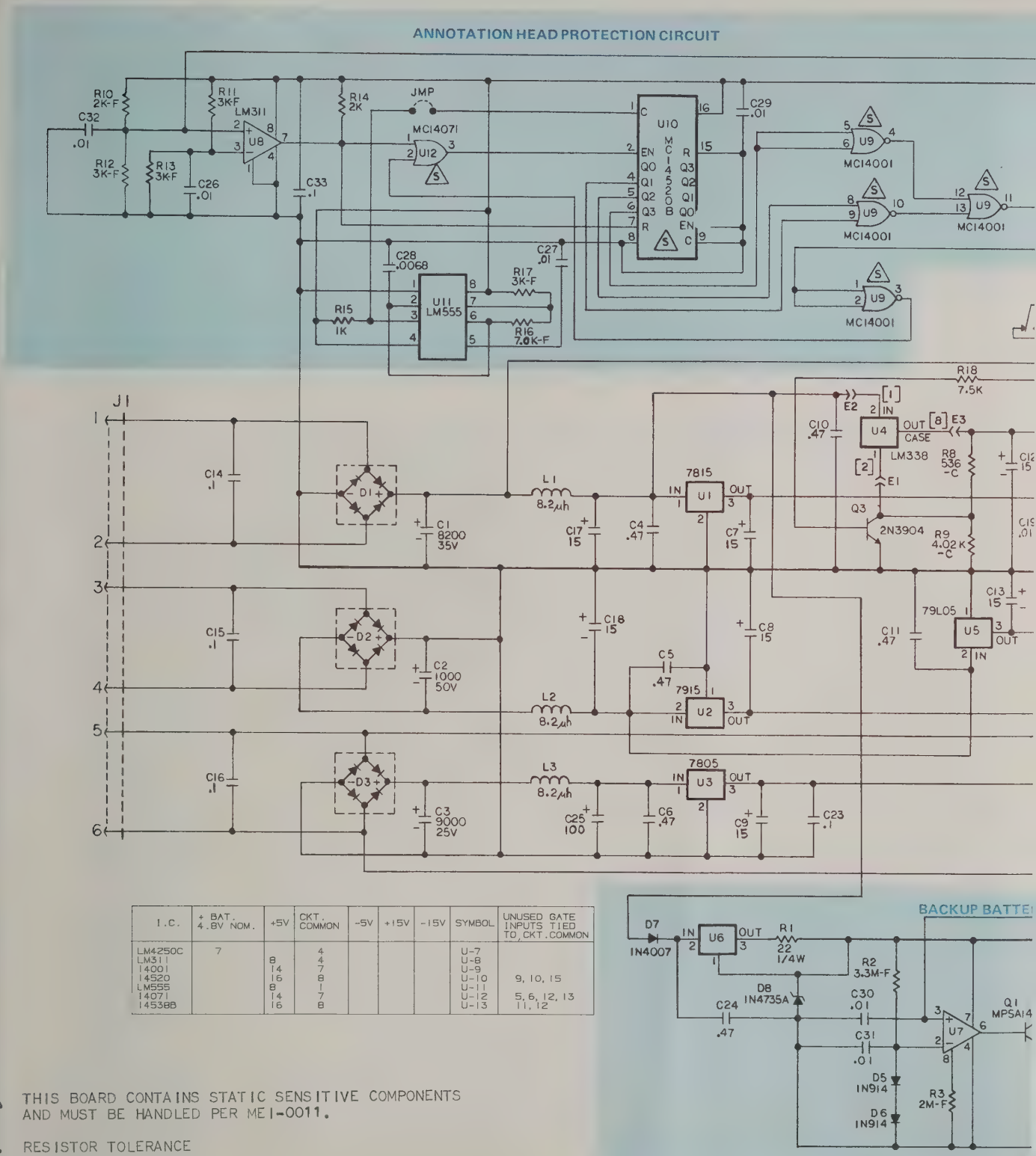
⚠S THIS BOARD CONTAINS STATIC SENSITIVE COMPONENTS AND MUST BE HANDLED PER ME1-0011.

2. RESISTOR TOLERANCE
F = 1.0%

1. UNLESS OTHERWISE INDICATED, ALL CAPACITANCE IN MICROFARADS.
ALL RESISTANCE IN OHMS.
ALL RESISTORS ± 5%, 1/4 WATT.

NOTES:


REVISIONS
SYM. | DESCRIPTION | DATE | APPROVAL
F-1 | ORIG. RELEASE ISSUE LEVEL DCN 30729/A. SOTEROS | 6-30-83 |
G-1 G-2 | CR8 WAS R45, 5.1K U35 PN 3,5,10,12 & U36 PN 3,5,10,12 WAS 9A DCN 30851 | 8-31-88 | SWARTZ
H-1 H-2 | R33 WAS 50K U16 WAS 74HC14 DCN 30928 | 10-19-83 | SWARTZ
J-1 | NOT AFFECTED PER DCN 31069 | 11-1-83 | A. SOTEROS
K-1 | NOT AFFECTED PER DCN 31086 | 11-1-83 | A. SOTEROS
M-1 | CR3 WAS 1N4148 PER DCN 31136 | | MF
1MHZ-Ø2
J2
2 S NE
1 COS
4 SINE GATE
5 COS GATE
PART OF J5
9 LED
8 LED
3 SWITCH
5 EXT. TRIG.
4 GND
J7
J8
4 TXD
2 COM
3 +5V
1 RXD
J9
2 HD. DR. D0
3 HD. DR. D1
4 HD. DR. D2
5 HD. DR. D3
6 HD. DR. D4
7 HD. DR. D5
8 HD. DR. D6
9 HD. DR. SUPPLY
J6-6
RS 232 PORT
MODEL NO. 210X-8890-XX BOARD ASS'Y., PROCESSOR 896073
BY | DATE
DR J. DAVIS | 6-30-83
CH
APP | 7-26-83
NAME SCHEMATIC
CODE IDENT. 96795
ISSUE CODE G
Gould Inc.
Instruments Division
Cleveland, Ohio 44114 U.S.A.
DWG. NO. 296073
SHEET 1 OF 2



I.C.	+ BAT. 4.8V NOM.	+5V	CKT. COMMON	-5V	+15V	-15V	SYMBOL	UNUSED GATE INPUTS TIED TO, CKT. COMMON
LM4250C	7		4				U-7	
LM311			4				U-8	
14001		14	7				U-9	
14520		16	8				U-10	9, 10, 15
LM555		8	1				U-11	
14071		14	7				U-12	5, 6, 12, 13
14538B		16	8				U-13	11, 12

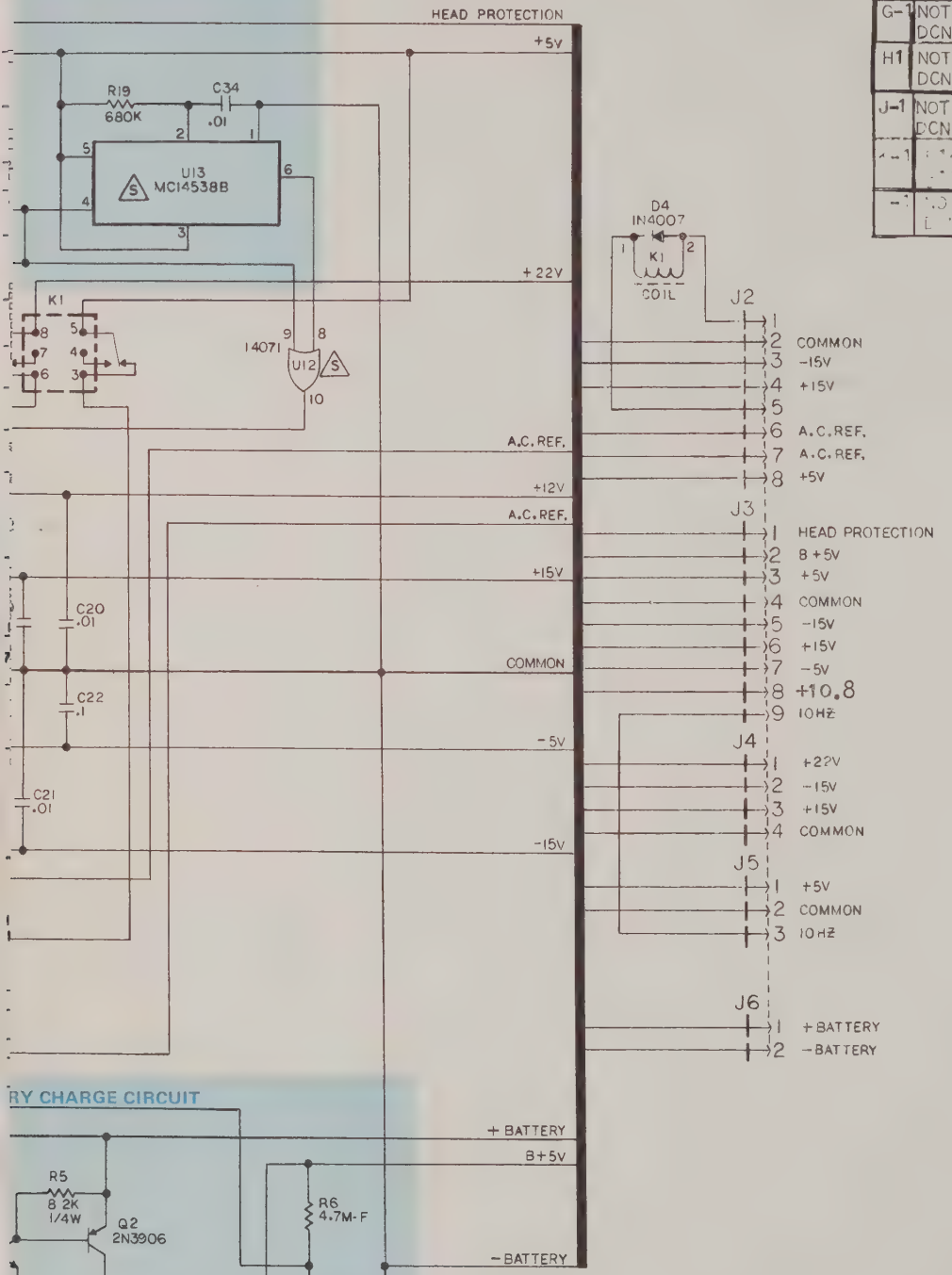
S THIS BOARD CONTAINS STATIC SENSITIVE COMPONENTS AND MUST BE HANDLED PER ME1-0011.

2. RESISTOR TOLERANCE
   C=.25%
   F=1.0%

1. UNLESS OTHERWISE INDICATED, ALL CAPACITANCE IN MICROFARADS.
   ALL RESISTANCE IN OHMS.
   ALL RESISTORS ± 5%, 1/4 WATT.

NOTES:

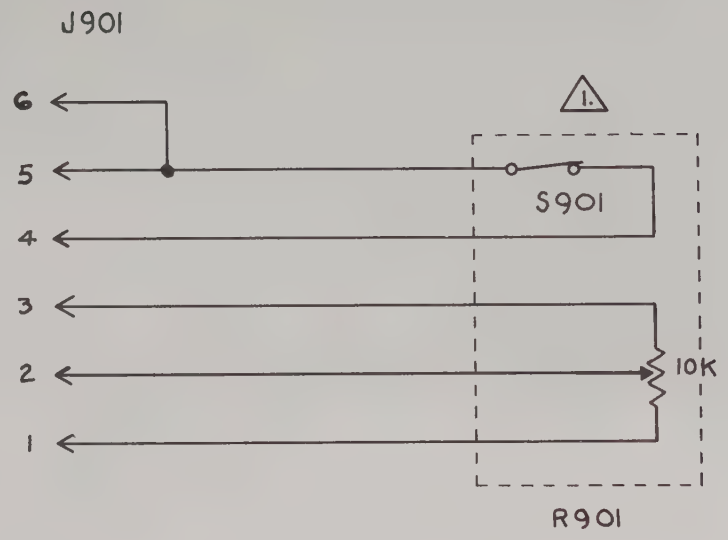
REVISIONS		
SYM	DESCRIPTION	DATE
F-1	ORIG. REL. ISSUE LEVEL DCN 30734/A. SOTEROS	6-30-83
G-1	NOT AFFECTED PER DCN 30788/A. SOTEROS	7-28-83
H1	NOT AFFECTED PER DCN 3089⁴ / S. JONES	9-21-83
J-1	NOT AFFECTED PER DCN 31081/A. SOTEROS	10-31-8[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]



MODEL NO. 210X-8890-XX BOARD ASS'Y., POWER SUPPLY

BY	DATE	NAME	Gould Inc. Instruments Division Cleveland, Ohio 44114 U.S.A.
DR J. DAVIS	7-13-83	SCHEMATIC	
CH D. Kostur	7/13/83		
APP B. Kiss	7-13-83		
		CODE IDENT. 96795	ISSUE CODE G
			DWG NO. 296449

REVISIONS		
SYM	DESCRIPTION	DATE
A-1	NOT AFFECTED PER DCN 26447/A. SOTEROS	5-23-80
B-1	NOT AFFECTED PER DCN 26908/S. HAMMOND	8-26-80
C-	CHANGED PIN NUMBERS PER DCN 26926 /S.HAMMOND	9-23-80
C-2	NOT AFFECTED PER DCN 26925/S.HAMMOND	9-23-80



1. SWITCH SHOWN IN DETENT POSITION

NOTES:

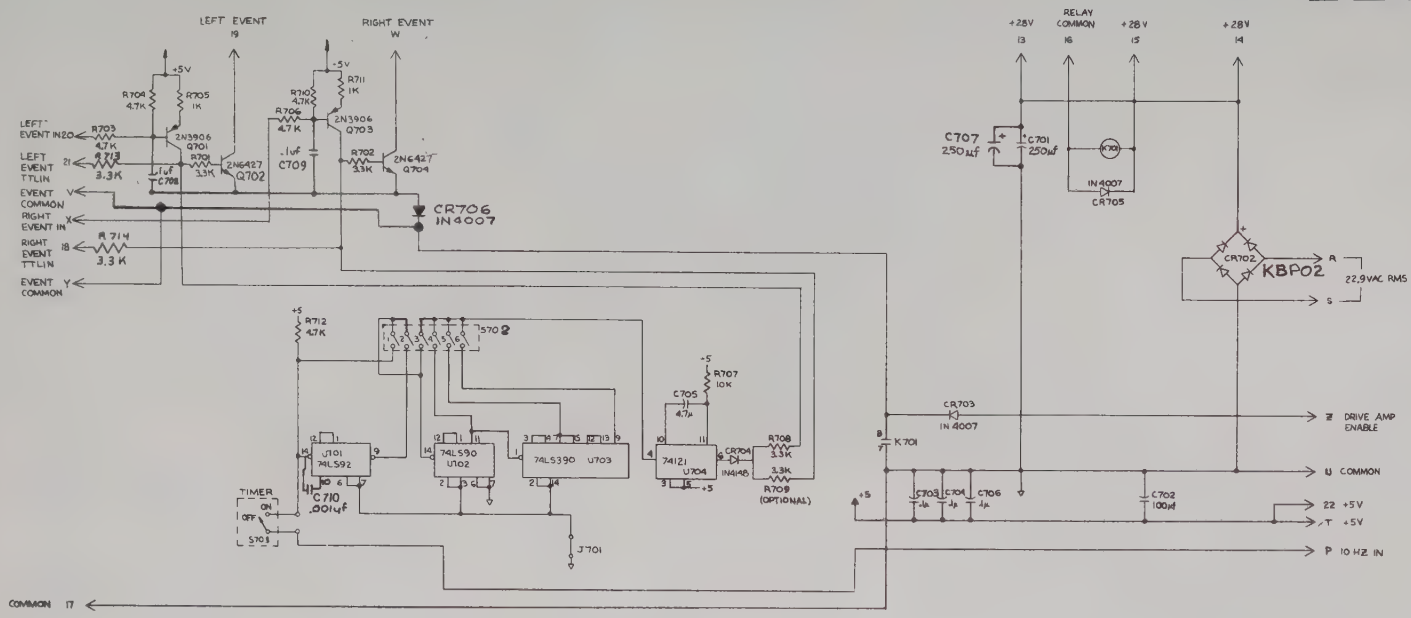
BD. ASS'Y., VARIABLE SPEED 893621

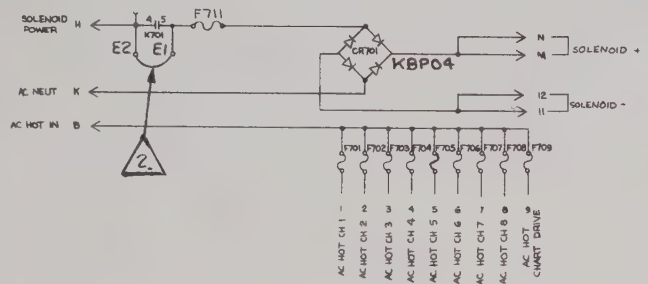
BY	DATE	NAME
S. HAMMOND	3-24-80	SCHEMATIC
	9/80	
	9/80	

CODE IDENT 96795 SIZE G

Gould Inc
Instruments Division
Cleveland Ohio 44114 U.S.A.
DWG NO. 293621

REVISIONS		
SYM	DESCRIPTION	DATE
AA-1	NOT AFFECTED PER DCN 31897 RIVERA	1-4-85
A&1	REV'D PER DCN 32164 RIVERA	7-15-85





S702 SETTINGS		
REP RATE	SW ON	SW OFF
.1 SEC	1,3	2,4,5,6
1 SEC.	1,4	2,3,5,6
10 SEC	1,3	2,4,5,6
100 SEC	1,6	2,3,4,5
.01 MIN.	2,3	1,4,5,6
.1 MIN	2,4	1,3,5,6
1 MIN	2,5	1,3,4,6
10 MIN	2,6	1,3,4,5

-00 = 115V
-01 = 100V
-06 = 230V
-07 = 200V

RECORDER FUSE TABLE				
	FOR-00	FOR-01	FOR-06	FOR-07
F701-F708	1 A,250V	1 A,250V	1/2 A,250V	1/2 A,250V
F709	1 A,250V	1 A,250V	3/4 A,250V	3/4 A,250V
F711 W/2 INK SOLENOIDS	1/4A,250V	1/4A,250V	1/4A,250V	1/4A,250V
F711 W/1 INK SOLENOIDS	1/8A,250V	1/8A,250V	1/8A,250V	1/8A,250V
F711 THERMAL 2 CHANNEL	1/4A,250V	1/4A,250V	1/4A,250V	1/4A,250V
F711 THERMAL 4 & 6 CHANNEL	1/2A,250V	1/2A,250V	1/2A,250V	1/2A,250V
F711 THERMAL 8 CHANNEL	3/4A,250V	3/4A,250V	3/4A,250V	3/4A,250V

2 ADD JUMPER, FOR THERMAL USE ONLY
1. ALL RESISTORS ARE 1/4 W, ±5%

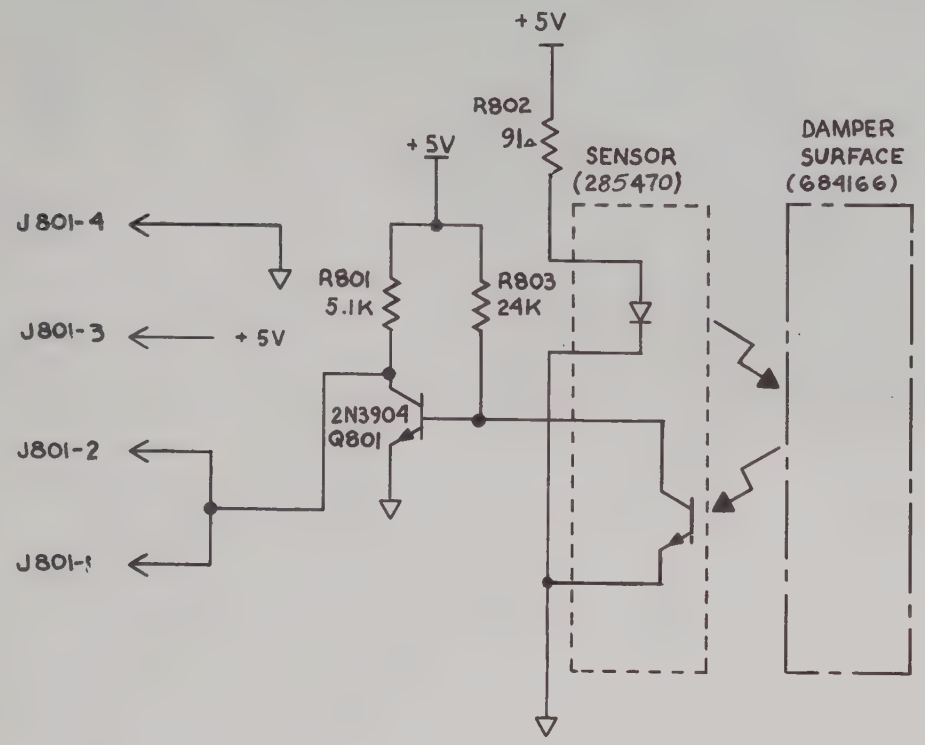
NOTES:

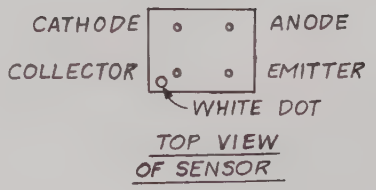
BY	DATE	NAME
DR WILLS	3/80	SCHEMATIC
CH LENARCIC	4/80	
APP DANIELS	4/80	CODE IDENT 96795 ISSUE CODE G

Gould Inc.
Instruments Division
Cleveland, Ohio 44114 U.S.A.
SIZE D DWG NO 294131

294131

REV K





TOP VIEW
OF SENSOR

294133

BD. ASS'Y.,
SENSOR 894133

NOTES:
ALL RESISTORS ARE 1/4W, ± 5%

BY	DATE	NAME	Gould Inc. Instruments Division Cleveland, Ohio 44114 U.S.A.
DR S. HAMMOND	9/24/80	SCHEMATIC-	
CH		CODE IDENT. 96795	ISSUE CODE G
APP			DWG. NO. 294133

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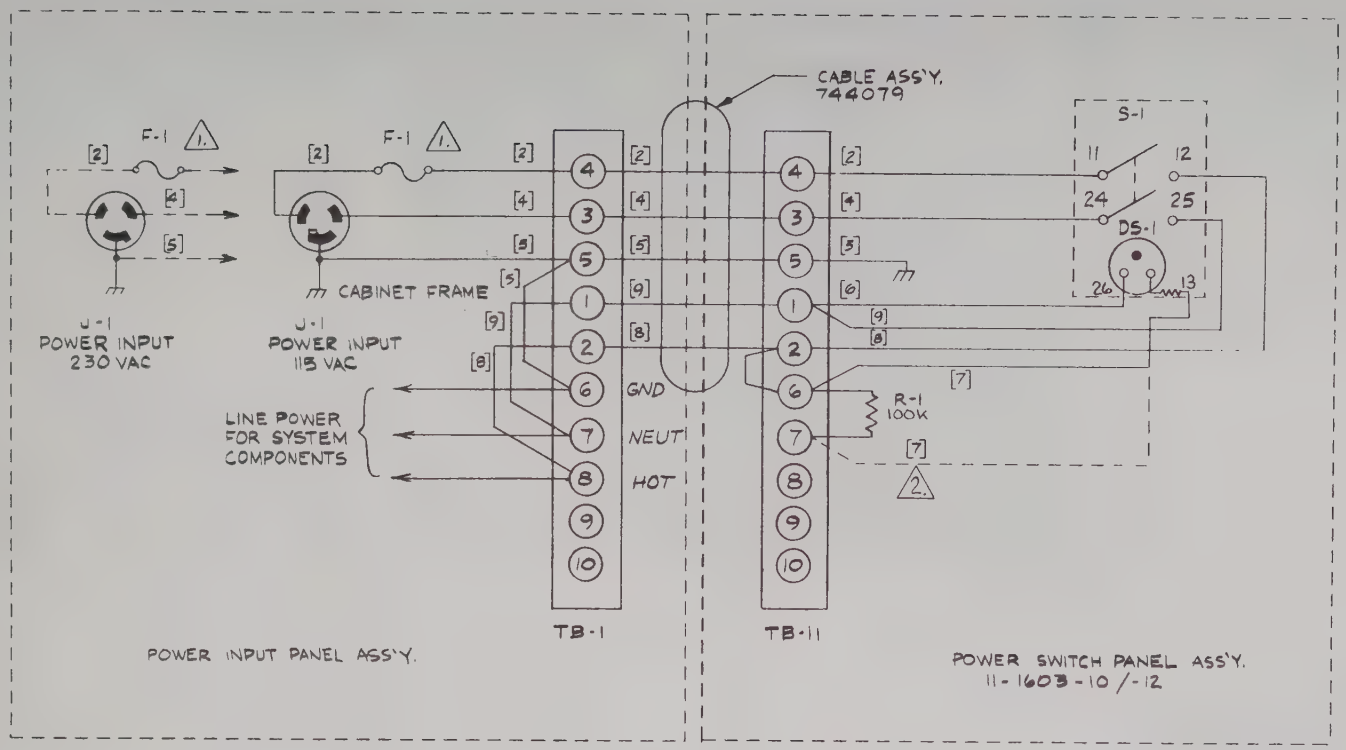
STM	DESCRIPTION	DATE
F-1	REVISED & REDRAWN PER DCN 30072/HAMMOND	11-8-82 P.TR.



1. [ ] = EIA COLOR CODE.

2. FOR 230V OPERATION MOVE WIRE [7] FROM TERMINAL 6 TO TERMINAL 7 OF TB-11.

1. FUSE RATING: 884208-1 & -5 (115 VAC) - 10A
884208-6 (230 VAC) - 5A

NOTES:

REQD	ITEM	PART NUMBER	DESCRIPTION	REMARKS	CML
			LIST OF MATERIAL		

S-2030 FIRST USE

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE PLATING
.XXX = ± .005 SURFACE
.XX = ± .015 FINISH
.X = ± .06 ANGLES = ± 0° 30'
SEE WORKMANSHIP STD-TITLED "MFG. TOLERANCES & STD'S.," WHEN DESIRED INTENT IS NOT CLEARLY DEFINED ON DRAWING

	BY	DATE
DR.	FOWLER	5-25-73
CH.		
APP	KLOSS	9-17-73

MATL. NONE

NAME: DIA., WIRING - POWER KIT

ADD FIN: NONE

ISSUE: G

CODE

SCALE

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DWG NO. 384919

FED. CODE NO. 96795

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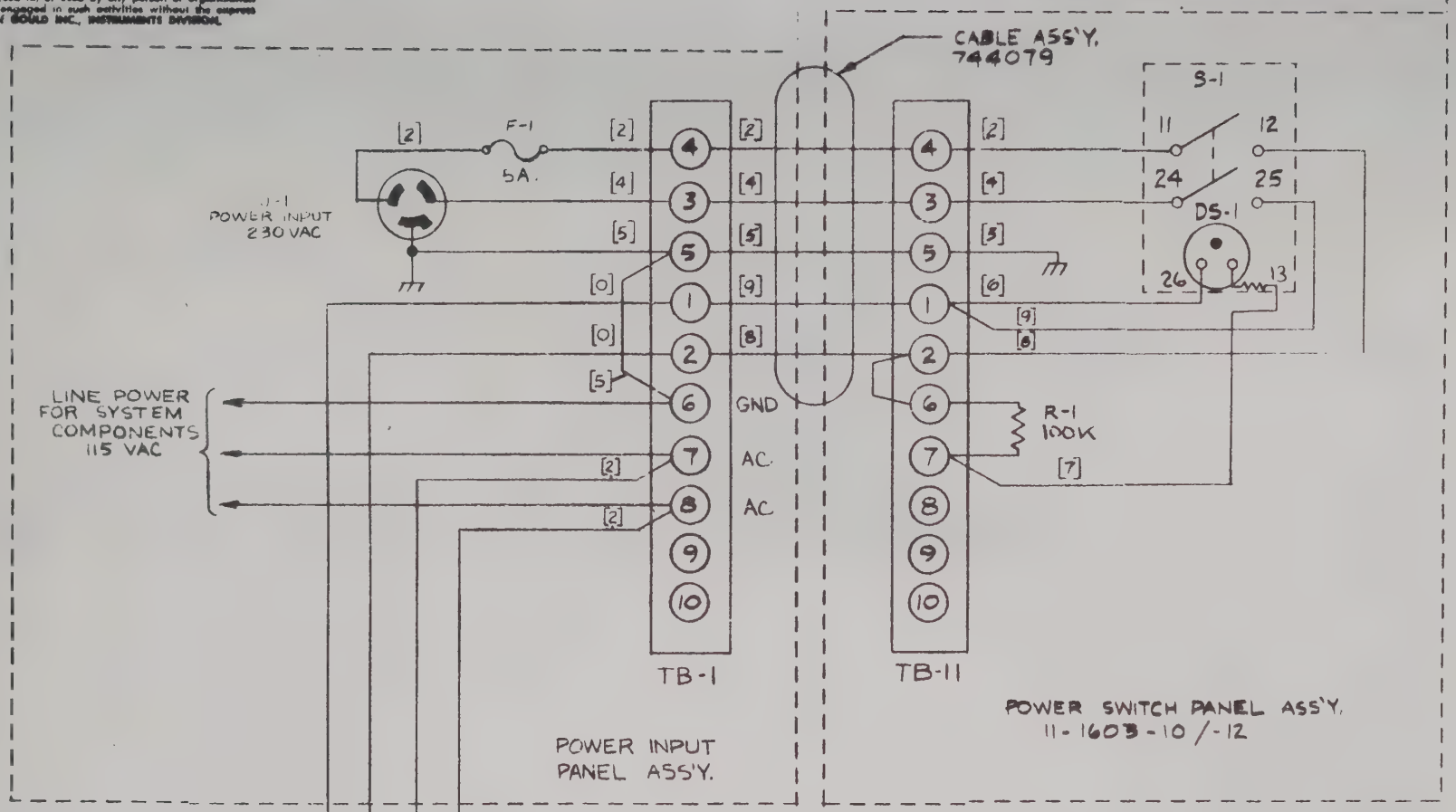
REVISIONS		
SYM.	DESCRIPTION	DATE
E-1	REVISED & REDRAWN PER DCN 30078/S.HAMMOND	11-6-73 PJ



2. [ ]=EIA COLOR CODE.

1. T-1 COMPONENT LEADS

NOTES:

BY	DATE	NAME
DR. FOWLER	5-24-73	DIAGRAM, WIRING- POWER KIT
CH.		
APP. KLOSS	9-17-73	

MATL.	ADD. FIN	ISSUE	DWG. NO.
NONE	NONE	G	384920
		CODE	
		SCALE	FED. CODE NO. 96795

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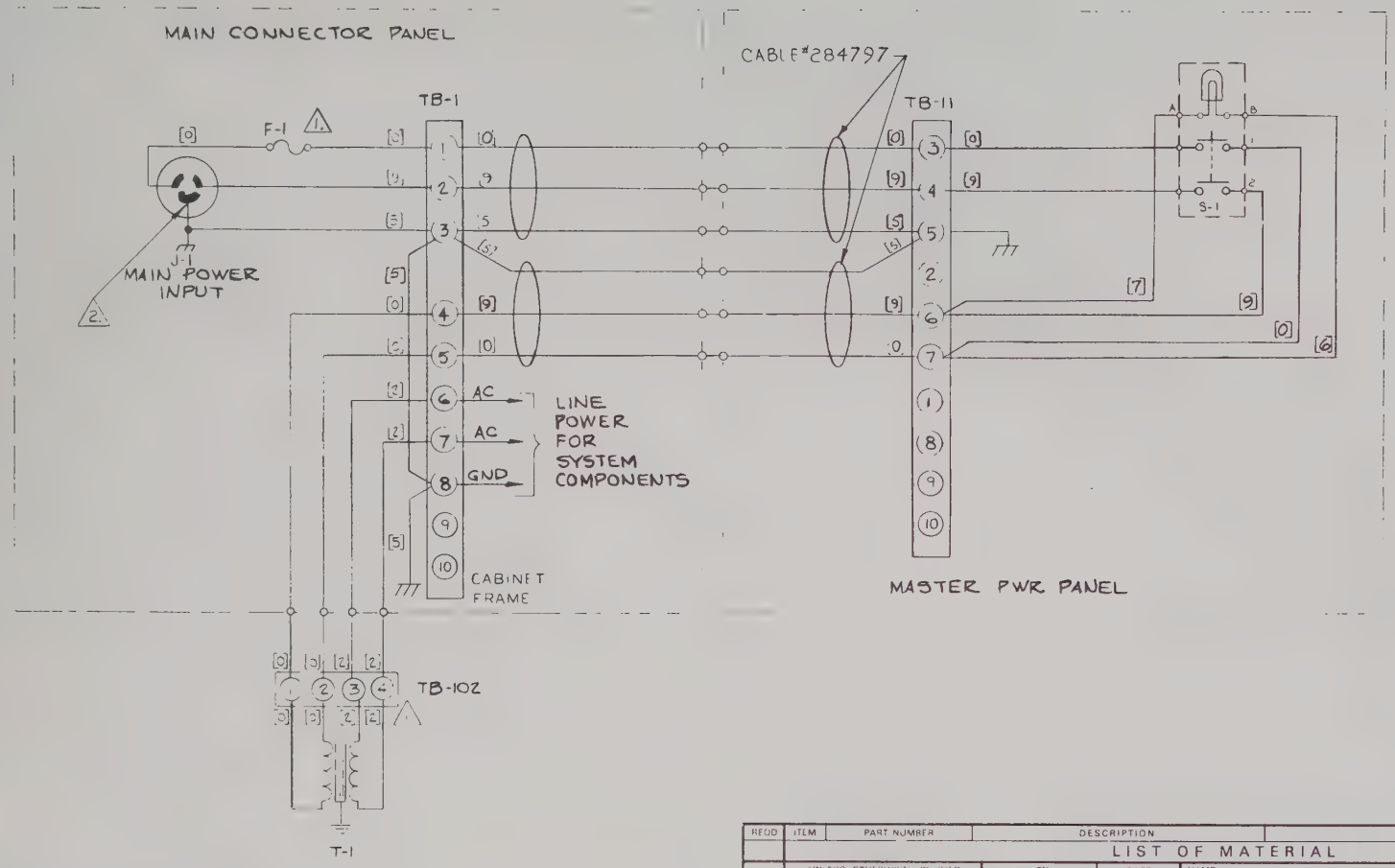

1. GROUND TERMINAL MUST BE CONNECTED DIRECTLY TO CHASSIS. (USE MTG. SCREW OF J-1.) GROUND LEADS [5] TO TB-1 WILL BE CONNECTED TO THE SAME MTG. SCREW.

2. FOR FUSE & TRANSFORMER CURRENT, VOLTAGE & [illegible] SEE DWG 284796 SUFFIX (REF)

REQD	ITEM	PART NUMBER	DESCRIPTION	REMARKS	CML

LIST OF MATERIAL

S-2029

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE PLATING
XXX ± .005 SURFACE FINISH
XX ± .015
X ± .06 ANGLES ± 1°

SEE WORKMANSHIP STD-TITLED "MFG. TOLERANCES & STD'S.."

ADD FIN

	BY	DATE
DR	FOWLER	5-25-73
CH		
APP		6-29-73

NAME: DIAGRAM WIRING
POWER KIT

FED CODE NO. 96795

ISSUE CODE

DWG NO 384961

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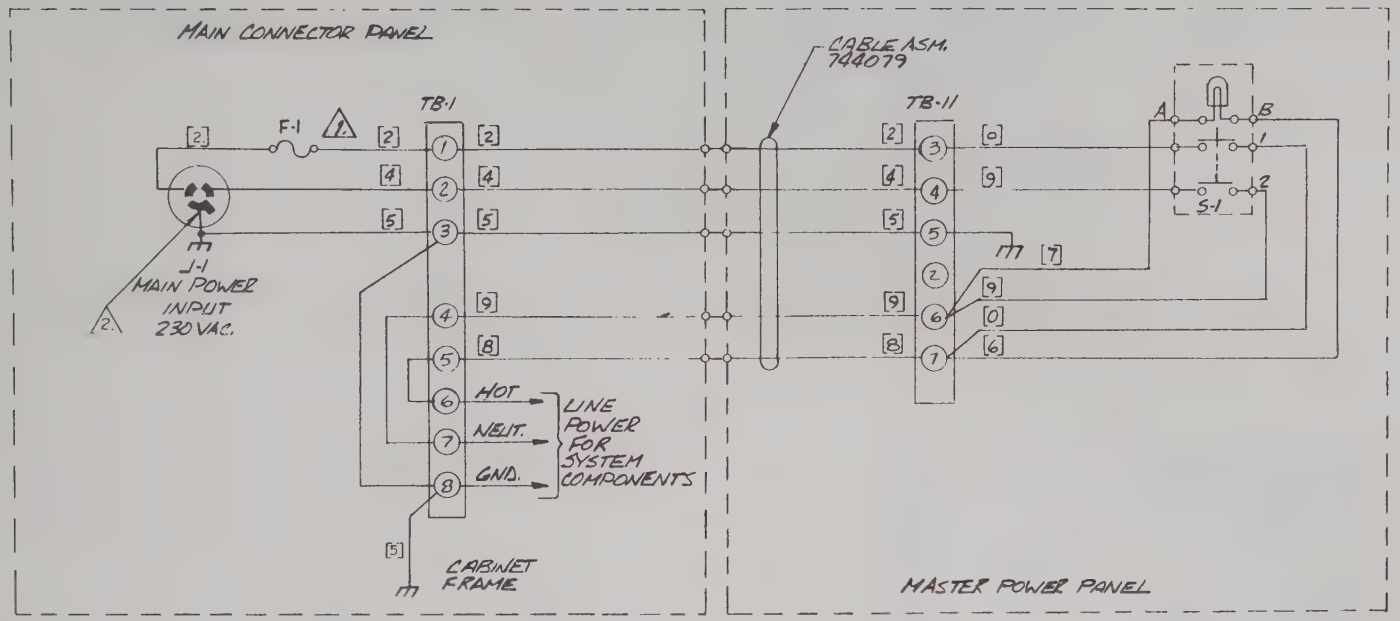
REV. B-1



⚠2 GROUND TERMINAL MUST BE CONNECTED DIRECTLY TO CHASSIS. (USE MTG. SCREW OF J-1.) GROUND LEADS [5] TO TB-1 WILL BE CONNECTED TO THE SAME MTG. SCREW.

⚠1 FOR FUSE RATING SEE DWG 884208 SUFFIX (REF.)

NOTE:

REQD	ITEM	PART NUMBER	DESCRIPTION	REMARKS	CML
			LIST OF MATERIAL		

884208-G FIRST USE

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE PLATING
XXX = ± .005 SURFACE FINISH
.XX = ± 016
.X = ± 06 ANGLES = ± 0° 30'

SEE WORKMANSHIP STD. TITLED "MFG. TOLERANCES & STD'S.." WHEN DESIRED INTENT IS NOT CLEARLY DEFINED ON DRAWING.

	BY	DATE
DR.	D. BAILEY	4-4-79
CH.		
APP.	KLOSS	4-5-79

ADD. FIN. NONE

NAME: DIAG. WIRING 884208-6, POWER KIT

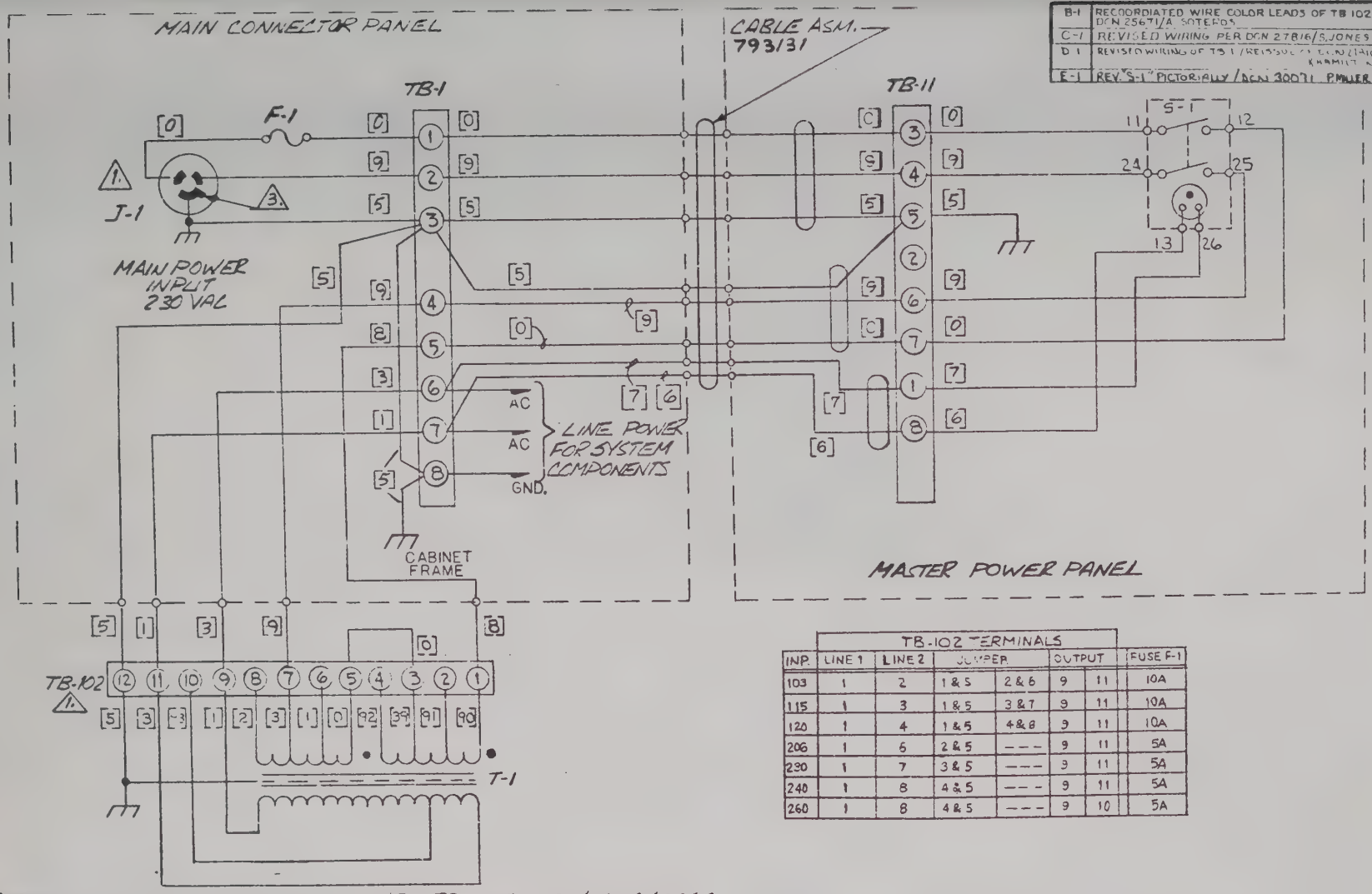
Gould Inc.
Instrument Systems Division
Cleveland, Ohio 44114 U.S.A.

FED. CODE NO. 96795

ISSUE CODE G

SCALE NONE

DWG NO 393042



REV	DESCRIPTION	DATE
B-1	RECOORDIATED WIRE COLOR LEADS OF TB 102. DCN 25671/A SOTEROS	11-8-79
C-1	REVISED WIRING PER DCN 27816/S.JONES	3-12-81
D-1	REVISED WIRING OF TB 1 (REASSIGNED TERMINALS) DCN 27816 KRAMITZ	4-27-81
E-1	REV. "S-1" PICTORIALLY / DCN 30071 PMILER	11-4-82

TB-102 TERMINALS							
INP.	LINE 1	LINE 2	JUMPER		OUTPUT		FUSE F-1
103	1	2	1 & 5	2 & 6	9	11	10A
115	1	3	1 & 5	3 & 7	9	11	10A
120	1	4	1 & 5	4 & 8	9	11	10A
206	1	6	2 & 5	---	9	11	5A
230	1	7	3 & 5	---	9	11	5A
240	1	8	4 & 5	---	9	11	5A
260	1	8	4 & 5	---	9	10	5A

3. GROUND TERMINAL MUST BE CONNECTED DIRECTLY TO CHASSIS (USE MTG. SCREW OF J-1). GROUND LEAD [5] TO TB-1 WILL BE CONNECTED TO THE SAME MTG. SCREW.
2. [ ] = E.I.A. COLOR CODE.
1. TRANSFORMER SHOWN FOR 230 VAC POWER INPUT.

NOTES:

RPOD	ITEM	PART NUMBER	DESCRIPTION	REMARKS	CML
			LIST OF MATERIAL		

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES AND INCLUDE PLATING
.XXX = ± .005 SURFACE FINISH
.XX = ± .015
.X = ± .06 ANGLES = ± 0° 30'

	BY	DATE
DR.	D. FAILEY	5-1-79
CH.	[illegible]	6-8-79
APP.	[illegible]	6-8-79

ADD FIN. NONE

NAME: WIRING DIAGRAM POWER KIT

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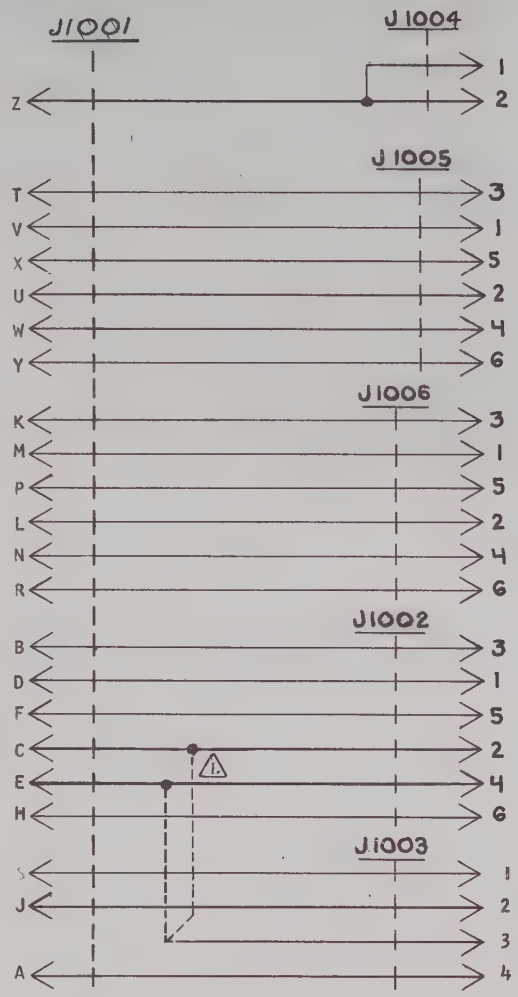
FED. CODE NO. 96795
ISSUE CODE G
SCALE NONE
DWG NO 393130

893136 FIRST USE

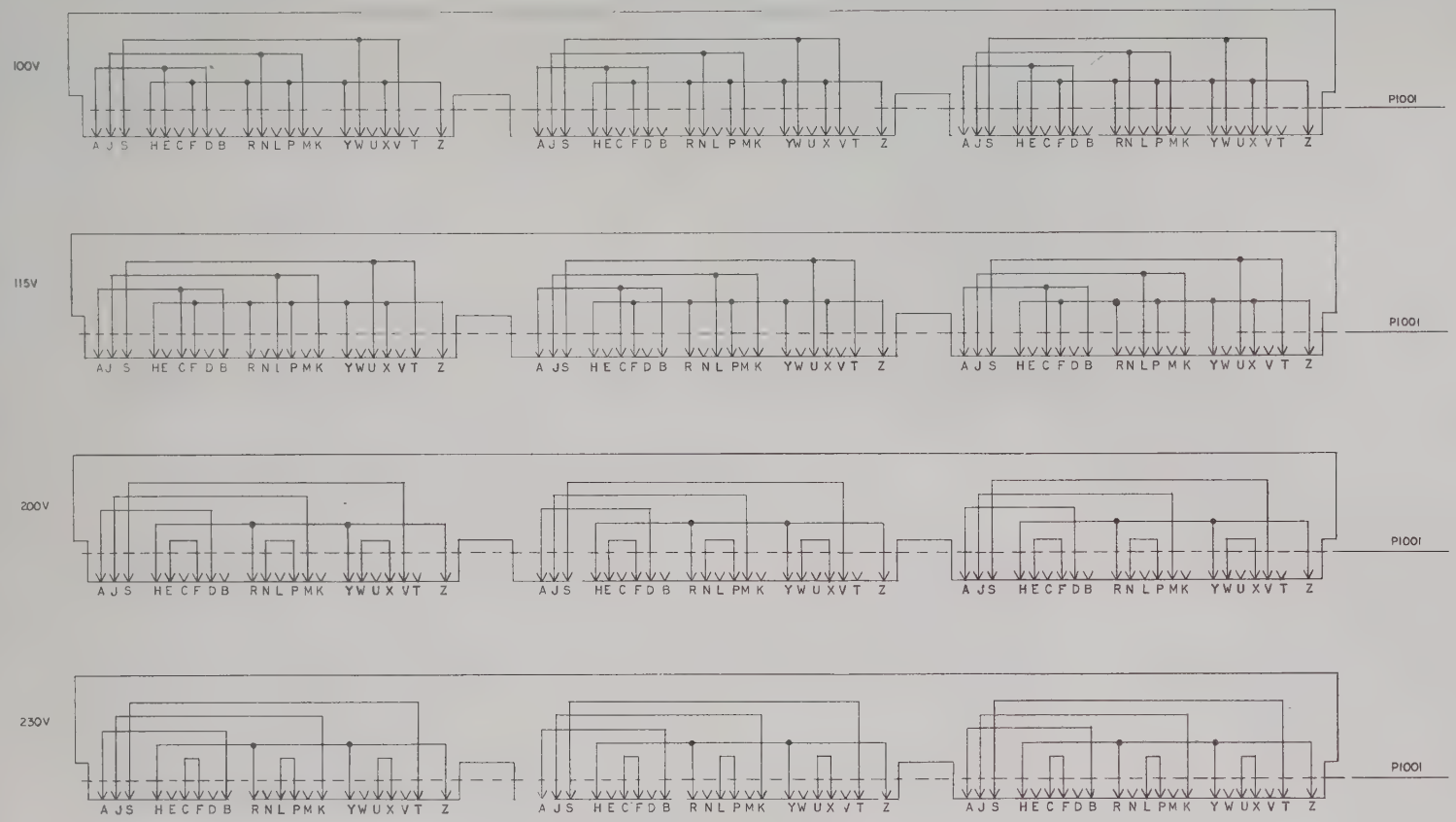


1. CONNECT PIN 3 ON J1003 TO PIN 4 OF J1002 FOR THE NONE SUFFIX AND CONNECT PIN 3 OF J1003 TO PIN 2 OF J1002 FOR THE -1 SUFFIX BOARD NUMBER 894286.

BD. ASS'Y. AC. DISTRIBUTION 894286

BY	DATE	NAME	Gould Inc. Instruments Division Cleveland, Ohio 44114 U.S.A.
DR S. HAMMOND	12/6/80	SCHEMATIC	
CH			DWG. NO. 294286
	9/80	CODE IDENT. 96795	ISSUE CODE 6

294286

REV B

BD., AC. DISTR. JUMPER 494704

BY	DATE	NAME
DR HAMMOND	7/11/80	SCHEMATIC
CH Chronicle	8/1/80	
APP Dan J	9/1/80	

CODE IDENT. 96795 | ISSUE CODE G

Gould Inc.
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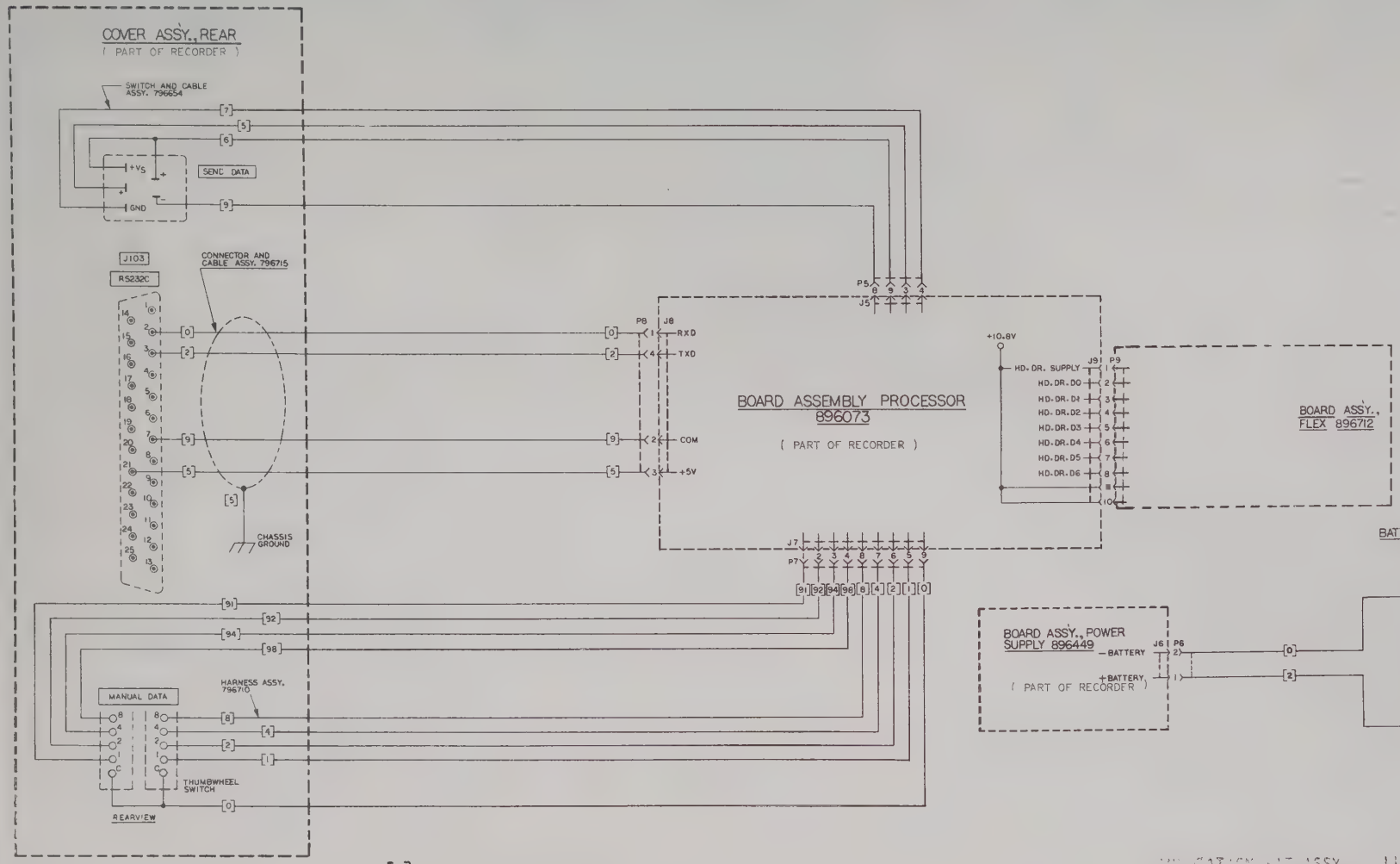
DWG. NO. 494704

494704

REV A



[illegible] APPLICATION KIT ASSY., 11-2123-51

BY	DATE	NAME
J. DAWS	8-1-83	

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CODE IDENT. 96795 | ISSUE CODE G | DWG. NO. 296820

296820

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